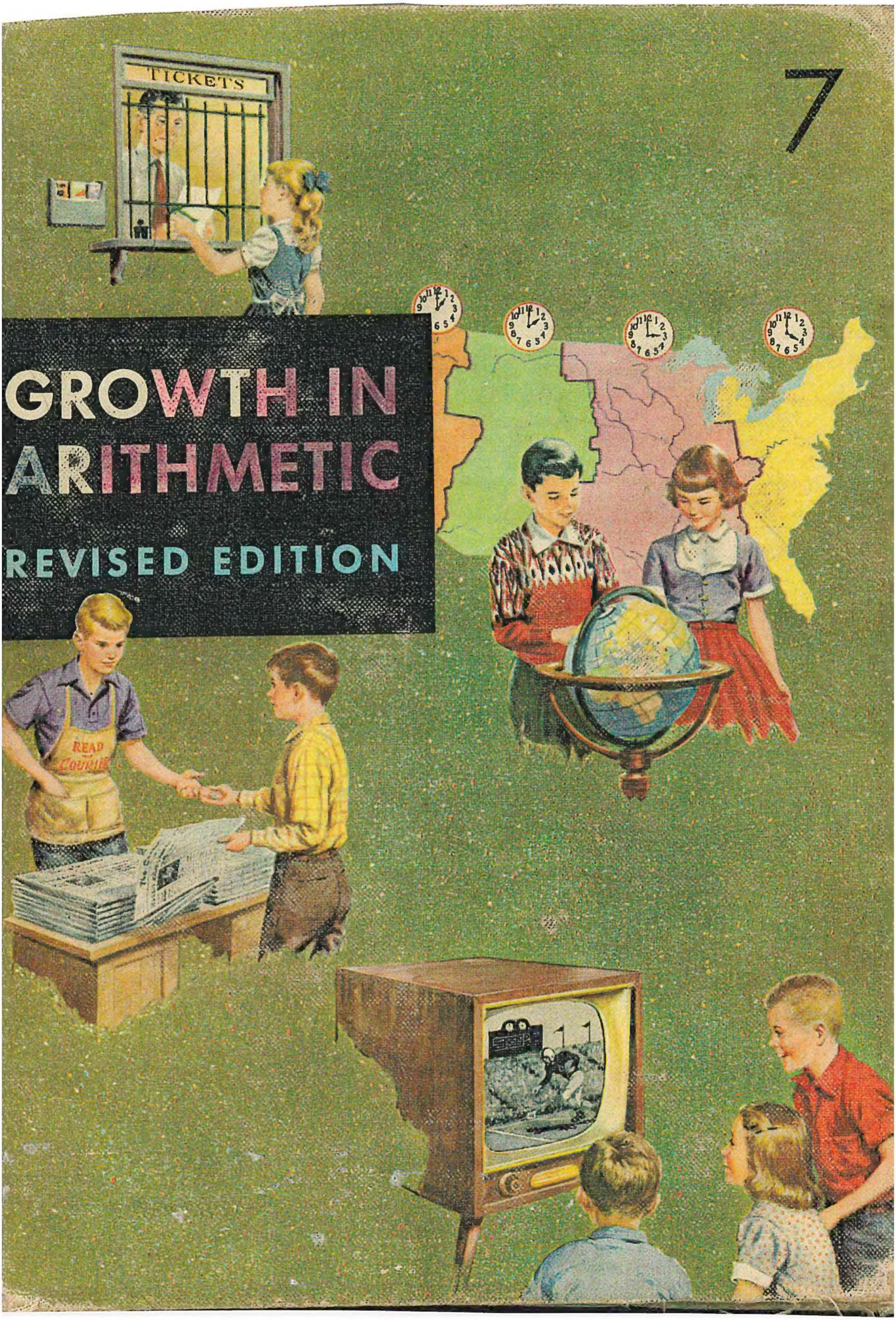

7
TICKETS
GROWTH IN
ARITHMETIC
REVISED EDITION
READ
COURIER

Growth In Arithmetic
Grade 7 (1956 Edition)

GROWTH

REVISED EDITION • **GRADE SEVEN**

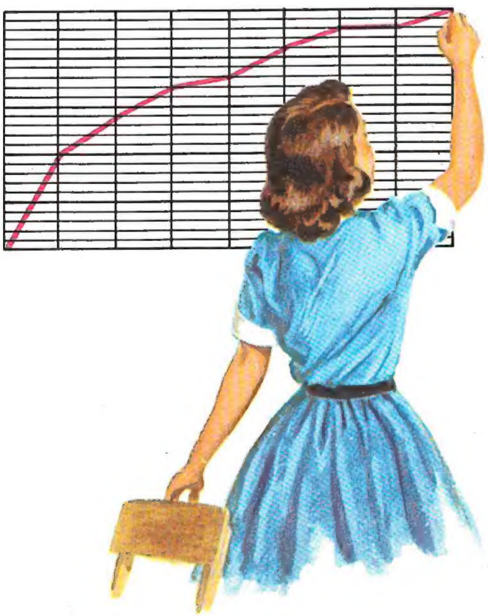
IN ARITHMETIC

BY John R. Clark

Rolland R. Smith

with the collaboration of

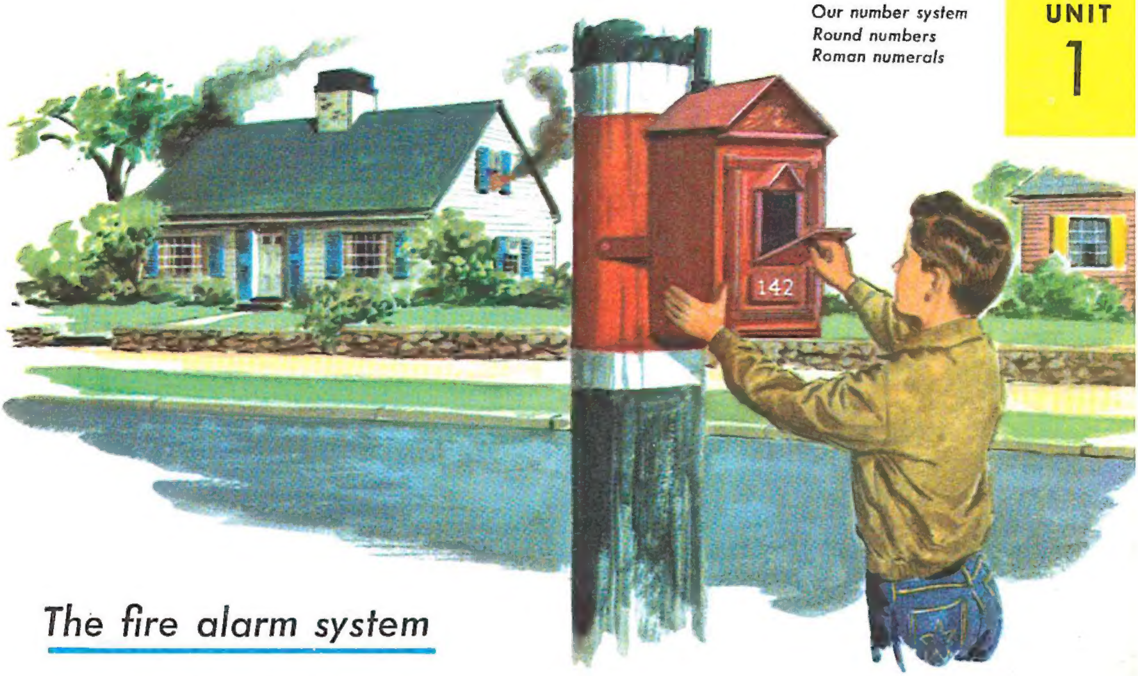
Harold E. Moser



WORLD BOOK COMPANY

Yonkers-on-Hudson, New York

Contents

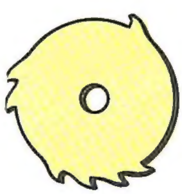


The fire alarm system

About eight o'clock one evening as Fred Greene was strolling along Page Boulevard he thought he smelled burning wood. Looking around he saw smoke coming from an attic window of a house. He ran at once to the fire alarm box on the corner and pulled open the door.

Arithmetic was far from uppermost in Fred's thoughts at the moment. But he soon discovered that arithmetic was important even in calling out the fire department. You will be surprised at the amount of arithmetic Fred had set in motion.

Fred used alarm box No. 142. When he pulled open the door, a wheel inside the box started turning and sent electrical signals to fire headquarters.

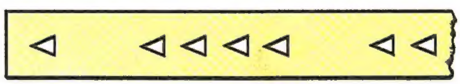


First one tooth on the wheel made one click for 1 *hundred.* Then there was a brief pause and four teeth made four clicks for 4 *tens.* After another brief pause, two teeth made two clicks for 2 *ones.*

Fred could hear the clicks 1–4–2. The wheel went around until the signal had clicked four times.

The alarm was given at headquarters in three ways:

- a red light flashed once, four times, and two times;
- a bell rang once, four times, and two times;
- a machine punched holes in a moving strip of paper like this:



Each signal was given four times.

The fireman on duty at headquarters waited for the first complete

signal, which came in rapidly — $\frac{3}{8}$ second for the 1 and an interval of silence for $\frac{15}{16}$ second; then $1\frac{1}{2}$ seconds for the 4 and silence for $\frac{15}{16}$ second; finally $\frac{3}{4}$ second for the 2.

The whole signal, 1–4–2, came in $4\frac{1}{2}$ seconds, as you can check by adding. The fireman then set a dial so that the number 142 was relayed to all 14 fire stations of the city.

At Station No. 6, assigned to box 142, the men started the engines of the hose wagon and the ladder truck as soon as the first signal was heard.

Within about 28 seconds from the time Fred opened the door at the alarm box, the signal had been heard four times at every station, and the 11 men at Station No. 6 were already on their way to the fire.

The hose wagon went first at a rate of about 30 miles an hour, or half a mile a minute.

Since the alarm box was only $\frac{1}{2}$ mile from the station, the hose wagon arrived in about 90 seconds and the somewhat slower ladder truck arrived in less than 2 minutes.

In a short space of time the firemen had put out the fire and relatively little damage had occurred.

1. Fred decided to find out more about the fire department in his city.

He learned that a hose wagon carries 750 feet of high pressure hose, 500 feet of low pressure hose, and 200 feet of light hose.

The hose wagon carries a total of _?_ feet of hose.

2. There are 330 alarm boxes which serve about 170,000 persons.

Does this mean that there is one box to about 50 persons, to about 500 persons, or to about 5000 persons?

3. A new alarm box costs $310, and the average cost of installing it is $1000; so the total cost of putting in a new alarm box is _?_.

4. A new fire station is being built in Fred's city at an estimated cost of $94,500. New fire apparatus for the station will cost $15,500.

The total cost of the station and apparatus will be _?_.

5. During one year there were 2699 fire alarms.

Since there are 365 days in a year, is the average number of alarms turned in each day about 2, about 7, or about 10?

6. The total fire loss in Fred's city during one year was $492,874.65.

Was the loss about $\frac{1}{2}$ million dollars, $\frac{1}{3}$ million dollars, or $\frac{1}{5}$ million dollars?

7. It is estimated that without the efficient work of the fire department in Fred's city the fire loss that year might have been at least $49,632,000.

Is this about 10 times, 100 times, or 1000 times the actual fire loss given in Ex. 6?

8. The fire loss for the entire country in the same year was $715,074,000.

Was this about $\frac{1}{4}$ billion dollars, $\frac{1}{2}$ billion dollars, or $\frac{3}{4}$ billion dollars?

Large numbers

BILLIONS			MILLIONS				THOUSANDS				UNITS		
Ten billions	Billions		Hundred millions	Ten millions	Millions		Hundred thousands	Ten thousands	Thousands		Hundreds	Tens	Units, or Ones
4	2	,	6	7	5	,	0	2	5	,	6	0	2

1. Read the number in the chart. It is an *11-digit,* or an *11-place,* or an *11-figure,* number.

2. Explain how to place commas to help you read a number.

3. Copy this number, putting in the other commas; 2657439,825. Read the number.

4. Joe said you need only one comma in a 4-, 5-, or 6-digit number. Was he right? Illustrate.

5. How many commas are needed in a 7-, an 8-, or a 9-digit number? Illustrate.

6. How many commas are needed in a 10-, an 11-, or a 12-digit number? Illustrate.

7. Alice read 40004400040 as: 40 billion, 4 million, 400 thousand, 40.

Copy the number. Place the commas. Then check Alice's reading.

8. Count:

- from 1000 to 10,000 by thousands.
- from 10,000 to 100,000 by ten thousands.
- from 100,000 to 1,000,000 by hundred thousands.
- from 1,000,000 to 10,000,000 by millions.

9. Now write the numbers you said in Ex. 8.

10. Leo says these four ways of writing money numbers mean the same. Do you agree?

- $4\frac{1}{2}$ million dollars
- $\$4\frac{1}{2}$ million
- $4,500,000
- $4.5 million

11. Write each of these in two other ways:

$3,500,000 $\$2\frac{3}{4}$ million

$5\frac{1}{4}$ million dollars

Large numbers

Read these sentences that are taken from daily newspapers:

1. In one year the airlines in the United States carried about 22,000,000 passengers.

2. A telephone company that serves five states reports that every minute of an average day 30,400 calls go over the wires. This is about 14,600,000 calls daily.

3. The new locomotives will weigh 1,010,700 lb.

4. The post-office department handles about 50,000,000 pieces of mail a year at a cost of about $2,800,000,000.

5. In 42,000,000 houses now wired for electricity there are 21,000,000 TV sets, 38,000,000 refrigerators and 32,000,000 washers.

6. The toll meters on the George Washington Bridge show that in one year 19,869,512 cars crossed the bridge.

7. You may find it hard to believe the figures of the National Safety Council on injuries to workers. Here they are:

At work, 2,050,000; away from work, 3,250,000.

8. Between April and August one fly might have 598,720,000 descendants if all the offspring lived and each female laid eggs.

9. The following table shows the receipts and expenditures of the United States Government from 1943 through 1953.

YEAR	RECEIPTS	EXPENDITURES
1943	$22,281,642,709	$ 79,705,536,575
1944	44,148,926,968	95,572,321,160
1945	46,456,554,580	100,397,472,705
1946	43,037,798,808	63,713,973,417
1947	43,258,833,189	42,505,045,529
1948	44,754,542,077	39,326,072,233
1949	38,245,667,810	40,057,107,858
1950	37,044,733,557	40,166,835,915
1951	48,142,604,533	44,632,821,908
1952	62,128,606,580	66,145,246,958
1953	65,218,336,563	74,607,420,232

10. In eight of the eleven years shown above the government's expenditures exceeded its receipts. In what three years did the receipts exceed the expenditures?

11. In what years were expenditures more than double the receipts?

12. What was the highest expenditure in these years? the smallest?

13. By how much did the expenditures exceed the receipts in 1953?

14. Can you explain how the government can spend so much more than it received in some years?

15. By what means has the government increased its receipts?

Helping you to understand our number system

1. Write in a column the ***integers*** (whole numbers) from 1 to 10.

2. Write in a second column the integers from 11 to 20.

3. In a third column write the integers from 21 to 30.

4. How are the numbers in the three columns alike? different?

5. Our number system is called a *tens* system, or a *decimal* system. This means it goes up by tens.

How do Exs. 1–4 show that our number system is a tens system?

6. 16 means ? ten and ? ones (or *units*).

7. 20 means ? tens and ? units.

8. Write the next ten integers after 80; after 90.

9. When you come to ten 10's, or 100, you again make use of the numbers 1, 2, 3, etc. Write one hundred *one*, one hundred *two*, one hundred *three*.

10. When you come to ten 100's or 1000, you make use of 1, 2, 3 again. Write one thousand *one*, one thousand *two*, one thousand *three*.

11. Exs. 9 and 10 also show that our number system is a tens system. Explain.

12. Start with 1,000,000 and write the next eight integers.

Write the next three integers after:

	a	*b*	*c*
13.	109	1099	12,099
14.	449	1999	12,999
15.	999	9,999	99,999
16.	1040	12,009	999,999

	1,000,000	100,000	10,000	1000	100	10	1
a	2	0	0	7	0	4	0
b							
c							

17. Make a large chart like the one here. Write the following numbers on the chart. Place each digit in the column that will give it the correct value. The first one is done for you.

Note how the zeros have to be put in.

a. 2 million, 7 thousand, forty

b. 3 thousand, 4 hundred twenty-eight

c. $4\frac{1}{2}$ million, 5 hundred nine

d. 6 thousand, fifty

e. 20 thousand, 6 hundred

f. 9 hundred thousand, 9 hundred nine

g. 1 thousand, 2 hundred sixty-four

h. 12 thousand, 4 hundred thirty-two

i. 35 thousand, nine

Reading and writing large numbers

1. Write the number that comes next after each of the following:

9	9,999	9,999,999
99	99,999	99,999,999
999	999,999	999,999,999

2. Write the number that is $\frac{1}{2}$ of each of the following:

10	10,000	10,000,000
100	100,000	100,000,000
1000	1,000,000	1,000,000,000

3. What is the largest 3-place number? the smallest 4-place number?

4. What is the largest 6-place number? the smallest 7-place number?

5. Mary got 237,059 for the answer to an addition example. She checked her work and found that the 7 should have been an 8. Her first answer was how much too small?

6. A seventh-grade class made this chart to show the meaning of the number 230,456.

2 hundred thousands →	200,000
3 ten thousands →	30,000
0 thousands →	0,000
4 hundreds →	400
5 tens →	50
6 units →	6
	230,456

Study the chart. Make a similar chart for each of the numbers below.

234,056 305,607 2,345,608

7. How does the chart in Ex. 6 show that the position or place of a digit in a number determines its value?

8. Write in figures:

- Four hundred thousand, two
- Fifty thousand, forty
- One million, six thousand, ten
- Two billion, eight hundred thousand
- Five million, five hundred six thousand, eighty

9. To write one thousand in figures, write a 1 and put __?__ zeros after it.

10. To write one million in figures, write a 1 and put __?__ zeros after it.

11. To write one billion in figures, write a 1 and put __?__ zeros after it.

12. Bill was trying to write the largest 3-figure number that contained only one zero. What is it?

13. What is the smallest 4-figure number that contains only one zero?

14. Bill said he thought that numbers would be easier to understand if they were printed this way:

$8^{7^{4^{2}}}$ $9^{3^{7^{5}}}$

What idea was he trying to emphasize?

Understanding a billion

It is easy to think of the size of small numbers such as 3, 5, or 25. It is not hard to think of 500. You have seen books with that many pages. Two books with 500 pages each would make 1000 pages.

But the size of a million or a billion! Their huge size is hard to understand. Here is some help.

▶ Suppose you started counting 1, 2, 3, 4, and so on — one number a second for seven hours a day.

● In one hour you would count to 60×60, or 3600. Explain.

● In one seven-hour day you would count to 7×3600, or __?__.

● At that rate it would take you nearly 4 days to count to 100,000 ($4 \times 25{,}200 =$ __?__).

● A million is not quite ten times 100,800. In forty days (10×4 days), you would be only slightly beyond 1,000,000 in your counting.

If you worked a five-day week, it would take you 8 weeks to count a million. Check this statement.

● A billion is 1000 million. To count to a billion would take 1000×8 weeks or 8000 weeks.

8000 weeks = __?__ years. (Allow 50 weeks to a year to give yourself a 2-weeks vacation each year.)

So, if you started counting at the age of 12 and kept counting until you were 65, you would count a little less than $\frac{1}{3}$ of a billion.

▶ Here is another way to think of a million and a billion.

● From New York to California is about 3000 miles.

● It is more than eight times that distance (25,000 miles) around the earth at the equator.

● Forty times around the earth at the equator would be about a million miles ($40 \times 25{,}000 =$ __?__).

● Forty thousand times around the earth would be a billion miles. ($1{,}000 \times 40 \times 25{,}000 =$ __?__).

1. Jane figures that a million is $10 \times 10 \times 10 \times 10 \times 10 \times 10$. Is she right?

2. Jane decided that a billion is $10 \times 10 \times 10 \times 10$, and so on. Complete her statement.

3. $100 \times 100 \times 100$ is a __?__.

4. $100 \times 100 \times 100 \times 100$ is a __?__.

5. 1000×1000 is a __?__.

6. $1000 \times 1000 \times 1000$ is a __?__.

Rounding off numbers

1. The paper stated "1500 Attend School Game."

Fred Johnson said, "That is in round numbers because we actually collected 1483 tickets." Is the number 1500 easier to remember than the number 1483?

2. If the number of tickets collected had been 1619, the paper probably would have stated "__?__ Attend School Game."

3. If you *round off* the following numbers to the *nearest hundred*, which numbers will become 500? Explain why.

504	576	476	492
540	420	498	503

4. Round off each number in Ex. 3 to the nearest 10.

5. The number 6576 lies between 6000 and 7000. The number halfway between 6000 and 7000 is 6500. Is 6576 nearer 6000 or 7000? When you round off 6576 to the nearest thousand you get __?__.

6. What number is halfway between each pair of numbers below?

a	*b*
700 and 800	56,000 and 57,000
6800 and 6900	56,300 and 56,400

c

3,600,000 and 3,700,000
3,457,000 and 3,458,000

7. Is 56,960 nearer 56,000 or 57,000? Think:

▶ What number is halfway between 56,000 and 57,000?

▶ 56,960 rounded off to the nearest thousand is __?__.

8. Round off to the nearest million each of the numbers under "expenditures" in the table on page 4.

9. Make a rule for rounding off numbers.

10. Round off these numbers to the nearest thousand.

a	*b*	*c*
8,518	6,744	2,324
20,252	27,667	892

Roman numerals

1. Where are Roman numerals ordinarily used?

2. Below are the letters most frequently used in writing Roman numerals. If there are any whose value you do not know, be sure to learn them before you go on.

I = 1 V = 5 X = 10 L = 50
C = 100 D = 500 M = 1000

3. II means two units, or _?_.

4. XXX means three tens, or _?_.

5. IV (*one before five*) means 1 less than 5, or _?_.

6. IX (*one before ten*) means 1 less than 10, or _?_.

7. XL (*ten before fifty*) means 10 less than 50, or _?_.

8. XC (*ten before a hundred*) means 10 less than 100, or _?_.

9. CM (*one hundred before a thousand*) means 100 less than 1000, or _?_.

10. VI (*one after five*) means 1 more than 5, or _?_.

11. XIV (*four after ten*) means 4 more than 10, or _?_.

12. LXXX (*thirty after fifty*) means 30 more than 50, or _?_.

13. CV (*five after a hundred*) means 5 more than 100 or _?_.

Which three of the following statements are incorrect?

	a	*b*	*c*	*d*
14.	XXVI = 26	LXIX = 69	CLXIII = 163	DCLXXXIV = 684
15.	XLVII = 47	MD = 1500	MDCX = 1610	MCMVIII = 1909
16.	LXVII = 57	MC = 1100	CXXVI = 124	MCMLII = 1952

Write in figures:

17. XLVIII MDCCCLXX

18. XCIX CXCIX

19. Can you tell from the illustration of this college building in what year the building was erected?

Information, please!

Before you can do these problems you need more information. Tell what information is missing and explain what you would have to know and do:

1. To find the total cost of an order of groceries.

2. To find how much change you should get when you pay for something.

3. To find how much you should collect for mowing your neighbor's lawn.

4. To find your average monthly savings.

5. To find your share of the cost of a class picnic.

6. To find how many gallons of gasoline it would take to drive your family car to a vacation spot in the mountains.

7. To find how many hours it would take to drive to the vacation spot in Ex. 6.

8. To find how much money you would have to save to buy inexpensive Christmas presents for your family and friends.

9. To find how many gallons of paint you would need in order to give your garage one coat of paint.

10. To find how many feet of fencing are needed to enclose a rectangular garden.

11. To find the cost of the fencing in Ex. 10.

12. To find the cost of a piece of roasting beef.

13. To find how far a car will run on a tankful of gasoline.

14. To find how many pounds of lawn grass seed are needed to seed a lawn.

15. To find the cost of a piece of ribbon for wrapping a gift package.

16. To find your age in years, months, and days.

17. To find how much more money you need in order to buy the bicycle you want.

18. To find your family's average daily expenditure for milk.

19. To find how much it cost your parents to support you this past year.

20. To find the number of steps you would take in walking a mile.

21. To find the number of words you use in a paragraph.

22. To find the average number of persons attending your neighborhood movie each night.

Using arithmetic

1. John is sending for a tool kit that costs $5.75 plus 35 cents for postage. He must send _?_.

2. A survey was made in Bill's town of the students who cannot swim. There were 500 non-swimmers in the elementary school, 412 in the junior high and 198 in the senior high. How many were there in all?

3. When Bill's father is away from home he telephones every day. If a day call is 70 cents and a call after 6 P.M. is 45 cents, how much can he save by making a call after 6 P.M.?

4. Alice has $10 to pay three bills. The bill for electricity is $2.60, for gas $3.48, and for telephone $3.76.

After the bills are paid, how much money should Alice have left?

5. Robert and Frank Wilson need one dozen pencils for school. They can buy one kind at 3 for 17¢ or another kind at 4 for 25¢. If the two kinds are about equal in quality, which is the better buy?

How much can the boys save by buying a dozen pencils at the lower price?

6. The Student Council raised money for a school fund by selling Mother's Day carnations.

They bought 500 flowers at $5.50 a hundred and sold them at 15¢ each. How much did the Council make?

7. The Whites bought an automobile for $2295. The annual insurance is $65.40 and the garage rent is $12 a month.

How much do the original cost and the insurance and rent for one year amount to?

8. On Saturday morning Mr. Carr bought a crate of 24 baskets of strawberries for $9.60. He sold most of the berries at 59¢ a basket. The last three baskets he sold for 35¢ each.

How much more than the cost did he receive for the crate?

9. Sally takes two piano lessons each week except for 4 weeks during the summer. Each lesson costs $1.25. Can you figure the cost of her lessons for two years?

10. Dick estimated the cost of his camping equipment as follows:

Tent, $6.95; sleeping bag, $13.95; mattress, $12.00; poncho, $5.00; duffel bag, $6.00; bucket, $1.00; canteen, $1.00. What was the total estimated cost?

11. Dick (Ex. 10) and his friend Tom bought a nylon tent for $13.98 and divided the cost. Dick then bought the following equipment:

Sleeping bag, $13.95; mattress, $7.95; used poncho, $2.50; used duffel bag, $.90; canvas bucket, $.85; canteen, $1.00. How much less than his estimate did Dick pay?

Everyday problems

1. The students in the drama class are giving a school play. They want to raise \$36 to buy a curtain for their stage.

Use the illustration to help you tell how many tickets they will need to sell to raise the money.

2. The girls' knitting club used 50 skeins of 4-ply yarn to knit an afghan. Each skein weighed 4 oz. At 19¢ an ounce, what did the yarn cost?

3. The boys in the print shop made calendar desk pads to sell. They spent 50 cents for the paper they used and one cent each for calendars. They made 200 calendar pads and sold them for ten cents each. How much more did they take in than they paid out?

4. John gets a good lunch at school for 25 cents a day. How much does he spend in 4 weeks of 5 days each?

5. Bill bought a flashlight for 79 cents, a knife for \$2.85, and a waterproof knapsack for \$3.50 to take to camp. How much did he spend for these three things?

6. A portable radio that usually sold for \$27.95 was marked \$19.00 for a quick sale. What is the difference between the prices?

7. Mrs. Brown bought 20 pounds of sugar. It was in 5-pound bags and cost 49 cents a bag. How much did the 20 pounds cost?

8. The Davis family are paying \$10.00 a month for a new refrigerator. They will pay this amount for 22 months. How much will their total payment amount to?

Reviewing addition

1. In the addition below, the numbers 327, 465, and 290 are called ? ; 1082 is called the ? .

$$\begin{array}{rl} 327 & \\ 465 & \text{addends} \\ \underline{290} & \\ 1082 & \text{sum} \end{array}$$

2. Explain how you check an addition. Does $5 + 7 = 7 + 5$? Does $4 + 3 + 2 = 2 + 3 + 4$?

3. Why are the addition facts on page 299 called *basic* addition facts?

See if you can write, on folded paper, the answers to those basic facts in 4 minutes.

4. Can the sum of two addends ever be equal to one of them? Illustrate.

5. Add 6 to 7; to 17; to 27; 37; 47; 57; 67; 77; 87; 97. All your answers end in ? .

Use this same principle in other examples, such as $6 + 8$ and $6 + 18$.

6. Add 7 to 5, add 7 to the sum, add 7 to the new sum, and so on until you reach a sum greater than 100.

You can make up similar examples that will give practice in adding numbers other than 7.

7. Copy and add the numbers at the right.

- Do you say 9, 14, 17, 22, 30?
- Do you say 9 and 5 are 14; 14 and 3 are 17, etc.?

Good computers prefer the first way. Do you see why?

$$\begin{array}{r} 9 \\ 5 \\ 3 \\ 5 \\ \underline{8} \\ ? \end{array}$$

Copy, add, and check:

8.	9.	10.	11.	12.	13.	14.
5	8	4	\$.68	87	238	345
6	4	5	.79	94	347	298
7	5	6	.87	46	476	876
4	9	9	.32	39	598	684
8	6	8	.54	87	620	839
9	6	7	.76	60	745	754

15.	16.	17.	18.	19.
\$9.86	\$12.98	2897	27346	27854
8.74	24.69	8654	58739	927
7.69	48.76	9876	820	40
4.68	58.64	8432	5643	8630
3.85	39.87	9874	87654	98007
5.37	31.25	8638	9832	4863

To the Teacher: See Note 1 on page 303.

Practice in addition

1. Bob rode his bicycle to the beach 6 days this week. His lunches for Monday through Friday cost him \$.47, \$.65, \$.59, \$.47, and \$.32.

Today he bought 2 hot dogs, 1 milk shake, and 1 apple pie.

What is the total cost of his lunches for the week?

2. The week before school opened, Mr. and Mrs. Allen drove to the camp where Jane had spent the summer. It took three days to get there.

The first day they drove 275 miles, the second day 345 miles, and the third morning 38 miles. How far did they drive in all?

3. The first day Mr. and Mrs. Allen drove from 8 to 12 o'clock and from 2 to 6.

The second day they drove from 8 to 12 and from 1 to 6.

The third day they drove over rough roads from 9 to 11.

What was their total driving time?

4. Mrs. Brown bought a hat for her daughter for \$2.98 and a coat for \$19.50.

She gave the clerk two 10-dollar bills and one 5-dollar bill. The clerk gave her \$2.52 in change.

Was that the correct amount of change?

Adding mentally

Sue, Mary, Tom, and Henry have different ideas about adding 37 and 28.

1. To add 37 and 28, Sue thinks, "37 and 20 are 57, and 8 are _?_."

2. To add 37 and 28, Mary thinks, "30 and 20 are 50; 7 and 8 are 15; so 37 and 28 are 50 + _?_, or _?_."

3. To add 37 and 28, Tom thinks, "37 and 30 are 67; 67 − 2 = _?_."

4. Henry adds 37 and 28 by thinking, "28 and 30 are 58, and 7 more are _?_."

5. Which way of adding 37 and 28 mentally do you prefer? Why?

Add these numbers mentally:

	a	b	c	d	e
6.	25 + 21	34 + 32	27 + 31	45 + 41	36 + 22
7.	26 + 16	45 + 15	37 + 17	56 + 16	28 + 18
8.	56 + 24	38 + 12	49 + 21	65 + 25	36 + 26
9.	37 + 13	27 + 16	36 + 15	28 + 13	29 + 12
10.	37 + 18	54 + 18	64 + 21	24 + 69	97 + 25
11.	34 + 29	56 + 28	59 + 32	18 + 78	98 + 36
12.	38 + 23	57 + 29	37 + 61	47 + 25	97 + 44
13.	46 + 15	55 + 18	29 + 63	98 + 14	98 + 56

14. To add 147 and 36, think, "147 and 30 are _?_, and 6 more are _?_."

15.	135 + 21	126 + 12	143 + 22	152 + 16	134 + 31
16.	165 + 15	146 + 16	128 + 18	127 + 17	145 + 15
17.	139 + 21	148 + 22	167 + 13	219 + 11	236 + 24
18.	126 + 15	138 + 13	217 + 14	234 + 15	117 + 16
19.	147 + 45	169 + 32	156 + 44	394 + 28	873 + 39
20.	156 + 38	137 + 28	196 + 54	487 + 23	984 + 21
21.	167 + 23	139 + 34	176 + 24	531 + 69	998 + 39
22.	158 + 32	146 + 24	243 + 18	867 + 34	990 + 67

To the Teacher: See Note 2 on page 303.

Thinking about carrying

A

$$\begin{array}{rl} 37 = & 3 \text{ tens } \ 7 \text{ units} \\ +25 = & \underline{2 \text{ tens } \ 5 \text{ units}} \\ & 5 \text{ tens } 12 \text{ units} = 6 \text{ tens } 2 \text{ units} = 62 \end{array}$$

B

$$\begin{array}{r} 37 \\ \underline{+25} \\ 62 \end{array}$$

C

$$\begin{array}{l} \ \ 3 \text{ weeks } \ 7 \text{ days} \\ \underline{+2 \text{ weeks } \ 5 \text{ days}} \\ \ \ 5 \text{ weeks } 12 \text{ days} = 6 \text{ weeks } 5 \text{ days} \end{array}$$

D

$$\begin{array}{l} \ \ 3 \text{ feet } \ 7 \text{ inches} \\ \underline{+2 \text{ feet } \ 5 \text{ inches}} \\ \ \ 5 \text{ feet } 12 \text{ inches} = 6 \text{ feet} \end{array}$$

1. Exs. *A* and *B* in the box above show two ways of finding the sum of 37 and 25. Explain each way.

How are the two ways alike? Why does everybody prefer to use the second way?

2. In Exs. *A* and *B* you see that 7 units and 5 units are _?_ units.

The 12 units are equal to _?_ ten and _?_ units.

You write the 2 in the units column. You *carry* the 1 ten to the tens column, and add it to the other tens.

3. Do these additions orally. Explain the carrying you do in each.

$$\begin{array}{r} 49 \\ 28 \\ \underline{35} \end{array} \qquad \begin{array}{r} 39 \\ 27 \\ \underline{18} \end{array} \qquad \begin{array}{r} 58 \\ 18 \\ 29 \\ \underline{17} \end{array} \qquad \begin{array}{r} 10 \\ 24 \\ 37 \\ \underline{82} \end{array}$$

4. Now explain the additions in Exs. *C* and *D* in the box above.

How are they alike? different?

5. Harry thinks:

- In Exs. *A* and *B* you change 12 units to _?_ ten and _?_ units. You *carry* the 1 ten to the tens column and leave the 2 in the units column.
- In Ex. *C* you change 12 days to _?_ week and _?_ days. You *carry* the 1 week to the weeks column and write 5 days in the days column.
- In Ex. *D* you change the 12 inches to _?_ foot. You *carry* the 1 foot to the feet column and have no inches left.

Harry says, "The carrying in the additions in the box would be simpler if the tens system applied in all of them."

6. Mary works as a baby sitter whenever she can.

One week she worked 2 hours 40 minutes and 3 hours 20 minutes. At 40 cents an hour, how much did she earn?

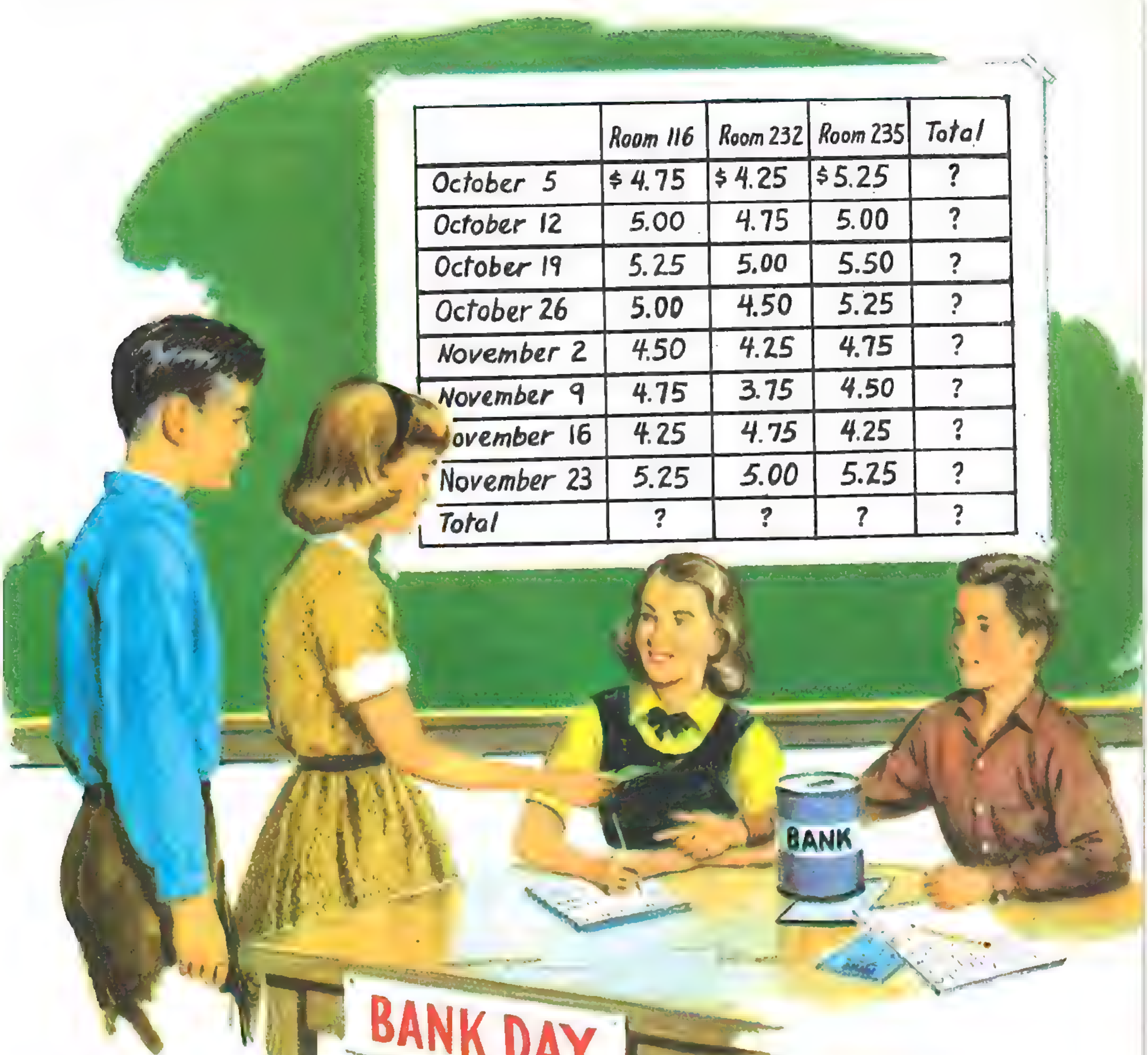
Find the following sums and explain each one:

7. $\begin{array}{l} 5 \text{ feet } 8 \text{ inches} \\ \underline{4 \text{ feet } 7 \text{ inches}} \end{array}$

8. $\begin{array}{l} 4 \text{ pounds } 10 \text{ ounces} \\ \underline{6 \text{ pounds } \ 8 \text{ ounces}} \end{array}$

9. $\begin{array}{l} 4 \text{ dimes } 8 \text{ cents} \\ \underline{3 \text{ dimes } 6 \text{ cents}} \end{array}$

10. $\begin{array}{r} 48 \\ \underline{36} \end{array}$



	Room 116	Room 232	Room 235	Total
October 5	$ 4.75	$ 4.25	$ 5.25	?
October 12	5.00	4.75	5.00	?
October 19	5.25	5.00	5.50	?
October 26	5.00	4.50	5.25	?
November 2	4.50	4.25	4.75	?
November 9	4.75	3.75	4.50	?
ovember 16	4.25	4.75	4.25	?
November 23	5.25	5.00	5.25	?
Total	?	?	?	?

Bank day

One day each week is "bank day" in the seventh-grade home rooms. The chart in the picture shows how much money was saved in three rooms in October and November.

1. Copy the table.

2. Find the total amount saved in each room during the two months and write the sums in the proper places in your table.

3. Find the total amount saved in the three rooms each week and write the sums in the proper places in your table.

4. Find in two ways the total amount saved in the three rooms and thus check your additions.

5. Tell how you would make an estimate to see if the total amount in Ex. 4 is sensible.

Reviewing subtraction

1. The seventh-grade School Improvement Club had \$45.68. It spent \$27.99 for books and had _?_ left.

\$45.68	**minuend**
27.99	**subtrahend**
\$17.69	**difference**

2. During the summer vacation Tom saved \$45.68. His younger brother saved \$27.99. Tom saved _?_ more than his younger brother.

3. Mary wants to buy a violin for \$45.68. She has \$27.99. How much more money will she need?

4. Joe says that Exs. 1–3 are all solved by subtraction, but:

- In Ex. 1 you find *how much is left.*
- In Ex. 2 you *compare* two numbers to find *how much larger one number is than the other.*
- In Ex. 3 you find *how much more is needed.*

Do you agree with Joe?

5. If in a subtraction example the minuend is 20 and the subtrahend is 13, the difference is _?_.

6. How would you check the subtraction 123 − 49 = 74?

7. The difference plus the subtrahend should equal the _?_.

8. Bill made a discovery while doing these subtractions:

13	23	43	103	703	1803
−8	−8	−8	−8	−8	−8
5	15	35	95	695	1795

Can you tell what principle Bill discovered? What other similar principles can you discover?

9. Can the difference and the minuend ever be equal? Illustrate.

10. Can the difference and the subtrahend ever be equal? Illustrate.

11. See if you can write in 4 minutes the answers to the basic subtraction facts on page 300.

Copy, subtract, and check:

	a	*b*	*c*	*d*	*e*
12.	56,000	80,000	75,008	74,324	80,750
	28,463	78,654	4,695	29,465	17,695
13.	\$50.00	\$75.00	\$85.25	\$70.05	\$90.60
	25.38	9.46	78.76	24.35	5.97
14.	80,700	54,000	37,820	58,493	63,500
	34,563	8,695	37,806	28,070	40,698

To the Teacher: See Note 1 on page 303.

Thinking about borrowing

A

$$\begin{array}{rl} 52 & = 5 \text{ tens } 2 \text{ units} = 4 \text{ tens } 12 \text{ units} \\ \underline{-\ 17} & = 1 \text{ ten } \ 7 \text{ units} = \underline{1 \text{ ten } \quad 7 \text{ units}} \\ & \qquad\qquad\qquad\quad\ \ 3 \text{ tens } \ 5 \text{ units} = 35 \end{array}$$

B

$$\begin{array}{r} \overset{4}{\cancel{5}}\overset{12}{\cancel{2}} \\ \underline{-\ 1\ 7} \\ 3\ 5 \end{array}$$

C

$$\begin{array}{rl} 5 \text{ lb. } 2 \text{ oz.} & = 4 \text{ lb. } 18 \text{ oz.} \\ \underline{-\ 1 \text{ lb. } 7 \text{ oz.}} & \underline{= 1 \text{ lb. } \quad 7 \text{ oz.}} \\ & \quad\ 3 \text{ lb. } 11 \text{ oz.} \end{array}$$

D

$$\begin{array}{rl} 5 \text{ ft. } 2 \text{ in.} & = 4 \text{ ft. } 14 \text{ in.} \\ \underline{-\ 1 \text{ ft. } 7 \text{ in.}} & \underline{= 1 \text{ ft. } \quad 7 \text{ in.}} \\ & \quad\ 3 \text{ ft. } \quad 7 \text{ in.} \end{array}$$

1. Exs. *A* and *B* in the box above show two ways of subtracting 17 from 52. Explain each way.

How are the two ways alike? How are they different? Which way do you prefer? Why?

2. In Exs. *A* and *B* you try to take 7 units from 2 units, but can't do it.

So you *borrow* 1 ten from the 5 tens and change the borrowed ten to units.

Then 5 tens 2 units becomes 4 tens 12 units.

Tell how to finish the subtraction in each case.

3. Do these subtractions orally. Explain the borrowing in each.

34	83	60	52
– 17	– 28	– 36	– 29

4. Now explain the subtractions in Exs. *C* and *D* in the box above.

How are they alike? How are they different?

5. Leo thinks:

- In Exs. *A* and *B* you *borrow* 1 ten from 5 tens and change the 1 ten to 10 units.

  So 5 tens 2 units = 4 tens __?__ units.

- In Ex. *C* you *borrow* 1 lb. from 5 lb. and change the 1 lb. to 16 oz.

  So 5 lb. 2 oz. = 4 lb. __?__ oz.

- In Ex. *D* you *borrow* 1 ft. from 5 ft. and change the 1 ft. to __?__ in.

  So 5 ft. 2 in. = 4 ft. __?__ in.

6. Do you think the borrowing in Exs. *A* and *B* in the box is simpler than the borrowing in Exs. *C* and *D*? Give a reason for your answer.

Do these subtractions. Explain the borrowing in each:

7. 5 yr. 2 mo.	**8.** 6 ft. 5 in.	**9.** 4 yd. 1 ft.
–1 yr. 3 mo.	–3 ft. 7 in.	–2 yd. 2 ft.
10. 4 hr. 20 min.	**11.** 6 lb. 4 oz.	**12.** 8 mo. 10 da.
–2 hr. 50 min.	–2 lb. 8 oz.	–5 mo. 25 da.

Subtracting mentally

No pencils please!

1. To find 72 − 23, George thought, "72 − 20 = 52; 52 − 3 = __?__."

	a	b	c	d	e
2.	73 − 25	82 − 35	91 − 24	93 − 36	87 − 29
3.	69 − 37	73 − 58	68 − 45	52 − 23	49 − 24
4.	97 − 45	93 − 54	97 − 66	87 − 29	78 − 39
5.	63 − 36	64 − 45	62 − 24	62 − 22	54 − 26
6.	42 − 19	50 − 28	63 − 37	74 − 47	84 − 56

7. To find 123 − 46, think, "123 − 40 = 83; 83 − 6 = __?__."

8.	123 − 56	132 − 45	144 − 67	156 − 28	163 − 47
9.	186 − 29	178 − 49	167 − 69	172 − 83	190 − 82
10.	297 − 99	192 − 65	170 − 72	181 − 92	192 − 97

11. To find 342 − 95, think, "342 − 100 = 242; 242 + 5 = __?__."

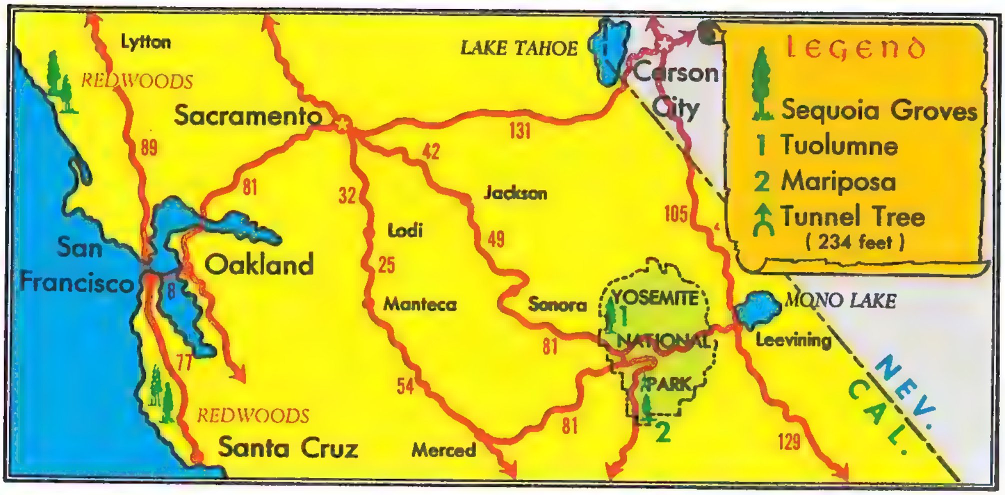
12.	351 − 95	427 − 99	503 − 98	605 − 94	716 − 98
13.	504 − 92	601 − 96	702 − 98	827 − 92	860 − 92
14.	703 − 104	723 − 105	856 − 203	982 − 106	895 − 106

In the following, tell what number N stands for. In the first example how can you figure out that N = 9?

	a	b	c
15.	$N + 5 = 14$	$N + 6 = 500$	$92 + N = 100$
16.	$80 - N = 58$	$90 - N = 36$	$100 - N = 49$
17.	$600 - N = 80$	$700 - N = 90$	$800 - N = 100$
18.	$N + 100 = 1000$	$1000 - N = 800$	$200 + N = 800$

19. I am thinking of a number. If I add 28 to it, the sum is 100. What is the number?

20. The sum of two numbers is 1000. One of the numbers is 302. What is the other number?



Reading an automobile road map

When Mr. and Mrs. Stone, Anne and Ted spent the summer vacation in California, they took a trip to see the great sequoia trees in Yosemite Park. They used a road map like the one on this page to plan their trip from Sacramento to Yosemite Park.

1. Find on the map the road from Sacramento to Merced. The numbers beside the red highway line give whole numbers of miles between places marked in this way •———• The distance from Sacramento to Lodi is 32 miles. From Lodi to Manteca is _?_ miles.

2. What is the distance from Sacramento to Merced?

3. The family stayed over night in Merced and drove the next day to Yosemite Park. The distance from Merced to inside the Park is _?_ miles.

4. In the Park they drove to the Mariposa Grove of sequoia trees. Many of these trees are over two thousand years old. The Stones drove through the tunnel tree. Find Mariposa Grove and the tunnel tree on the map. This tree is about _?_ feet tall.

5. On the return trip to Sacramento, Mr. Stone drove through Sonora and Jackson. Look at the map and then tell what the distance is from inside the Park to Sacramento by this route.

6. Anne and Ted said that the total number of miles for the whole trip was about 400. Follow the route from Sacramento to Yosemite Park and back through Sonora. By the map the total number of miles is _?_.

Explain why Anne and Ted could say that the total number of miles was about 400.

The Mathematics Club

During the summer Tom had read about some interesting mathematical puzzles and Bill had found directions for making models of some geometric objects.

They thought it would be a good idea to have a Mathematics Club, where they might learn more about these and other interesting mathematical ideas.

1. They were able to interest 38 other students, making _?_ members in all. Tom was elected president and Bill was made secretary and treasurer of the club.

2. The members of the club needed money to buy books, cardboard, scissors, and string. So they voted that each member should earn money to pay dues of $1.00 a year.

The estimated expense was: books, $8.50; cardboard, $4.65; 6 pairs of scissors, $10.00; string, $.35. The total estimated expense was _?_.

At the next meeting the members reported on the ways they had earned money. In Exs. 3–5 you learn what some members did to earn their dues.

3. Tony had worked for his father, a market gardener, and had earned 65¢ on Monday, 75¢ on Tuesday, 50¢ on Wednesday, 55¢ on Thursday, and 60¢ on Friday. Tony earned _?_ in the five days.

4. Mary bought 50 plain cards for 69¢. After painting Christmas designs on them, she sold them for 5¢ each. She earned _?_.

5. Martha agreed to have her shoes repaired instead of buying the new ones she wanted.

The repair work cost $1.95. The new shoes would have cost $6.45.

Martha saved _?_ and her mother said she had earned that amount.

6. Eighteen members had earned enough to pay the dues of $1.00. That made _?_ in the treasury.

7. After paying for the cardboard, scissors, and string as estimated in Ex. 2, there would be _?_ left in the treasury.

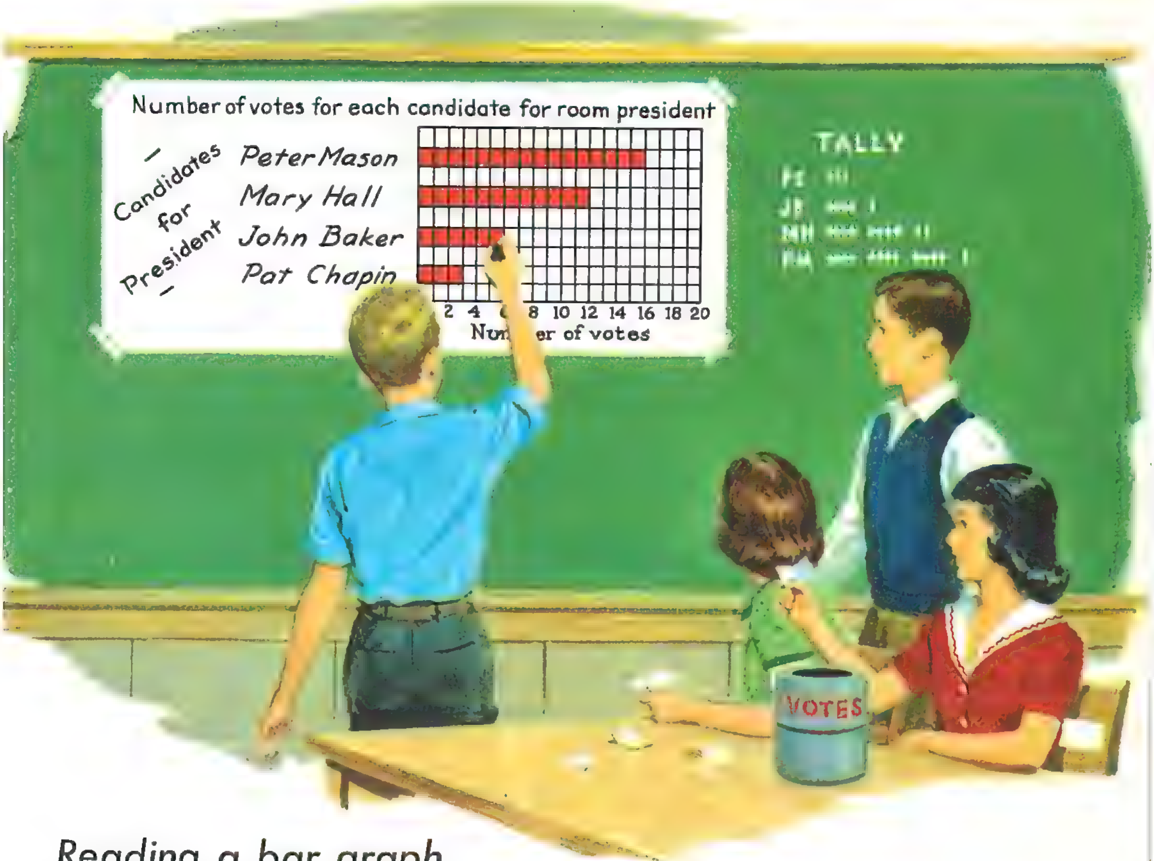
When the other members paid, there would be _?_ more in the treasury.

8. At the third meeting the remaining dues were paid and then there was _?_ in the treasury.

The members then bought books costing $8.50 and had _?_ left for other expenses.

9. George wanted to join the Mathematics Club. He decided he could spare 15¢ each week from the money he earned. In how many weeks could he pay his dues?

10. Have you ever been secretary and treasurer of a club? If so, what problems did you have to solve?



Reading a bar graph

Each home room in the Jones School elects a room president. This *bar graph* shows how the students voted in Room 112. Can you answer the following questions?

1. I can see at a glance that the greatest number of votes were cast for __?__ and the least number of votes for __?__.

2. The graph shows that __?__ students voted for Peter Mason, __?__ for Mary Hall, __?__ for John Baker, and __?__ for Pat Chapin.

3. The title of the bar graph shown above is __?__.

4. The *scale* is at the bottom of the graph. What does each unit along the horizontal line represent?

5. If this were a graph showing the number of votes for the President of the United States, the number of votes would be given in very large numbers.

You would probably round them off to millions before you tried to make a graph.

Round off the following numbers of votes to the nearest million:

Candidate 1.	24,045,052
Candidate 2.	21,896,927
Candidate 3.	1,768,687
Candidate 4.	1,137,957

Reading a bar graph

The seventh-grade classes in Springdale School were studying the history of their city. In the library they found these facts about the population:

YEAR	POPULATION
1815	2,312
1835	3,914
1855	10,985
1875	14,899
1895	30,340
1915	60,059
1935	95,614
1955	100,104

George saw the bar graph shown below in the Sunday Supplement and brought it to class. In the graph the population has been rounded off to thousands.

1. Look at the scale and read the numbers. Does the 20 stand for 20 thousand or 20 million?

2. Does one unit of horizontal length represent 1 thousand or 2 thousand?

3. How long a bar would represent 1 thousand on this graph? 3 thousand? 15 thousand?

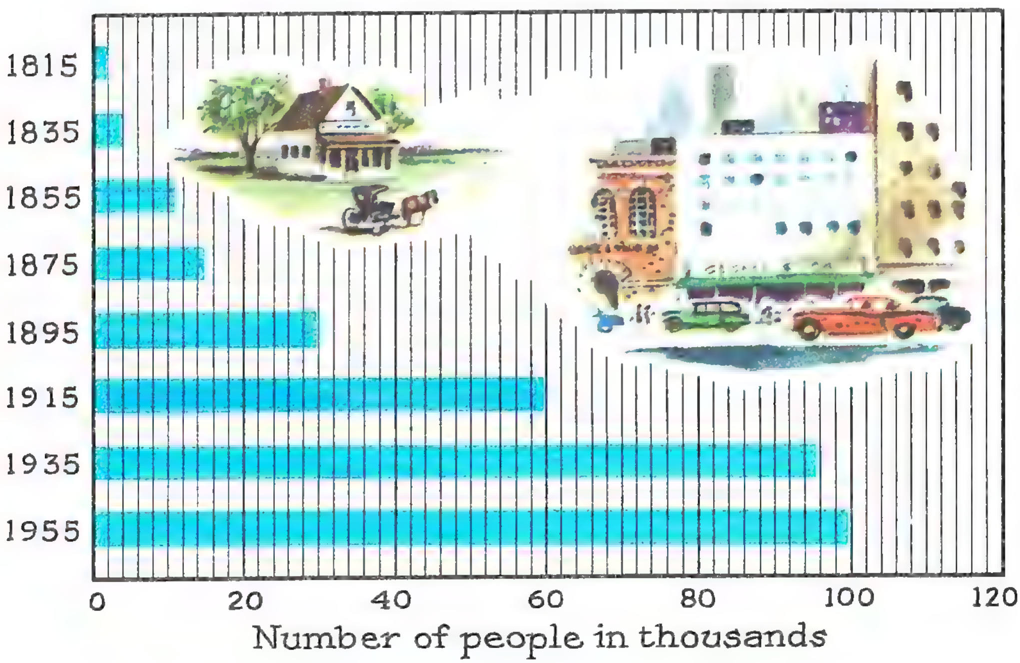
4. According to the graph, what was the population of Springdale in 1855? in 1835?

What was the increase in population from 1835 to 1855?

5. Look at the graph and tell the population for each date shown.

6. Round off the numbers in the table and check with the graph to see if it is right.

GROWTH IN POPULATION OF SPRINGDALE



round number to nearest 10

Making bar graphs

Mary Allen is making a bar graph to show the approximate speed in miles per hour (m.p.h.) of birds in flight. She has these data (facts).

KIND OF BIRD	SPEED IN M.P.H.
Turkey vulture	15
Robin	30
Bobwhite quail	40
Starling	45
Humming bird	55
Golden plover	70

- How many bars will she have?
- The longest bar will represent _?_ m.p.h.; the shortest will represent _?_ m.p.h.
- The horizontal scale should run from 0 to a little more than _?_.
- The widths of the bars and the spaces between should be _?_.
- She should allow room at the left for the names of the _?_.
- What is a good title for the graph? Where should it be placed?
- Mary plans to place the bars in order of size, the shortest at the top. Is that a good idea?
- Mary is using "cross-section" or "cross-ruled" paper rather than plain unruled paper. Why?

1. Make a bar graph to show Mary's data.

2. The campers' choices of non-athletic activities in 5 summer camps are given in the table below.

ACTIVITY	NUMBER CHOOSING
Boat modeling	41
Weaving	62
Glee club	73
Wood carving	99
Band	120
Bird lore	147
Care of animals	178

Make a bar graph to show the data in the table. (Round off the numbers to the nearest ten.)

3. In a track meet between the Roosevelt, Wilson, Lincoln, and Washington schools these points were made.

Make a bar graph to show the number of points won by each school.

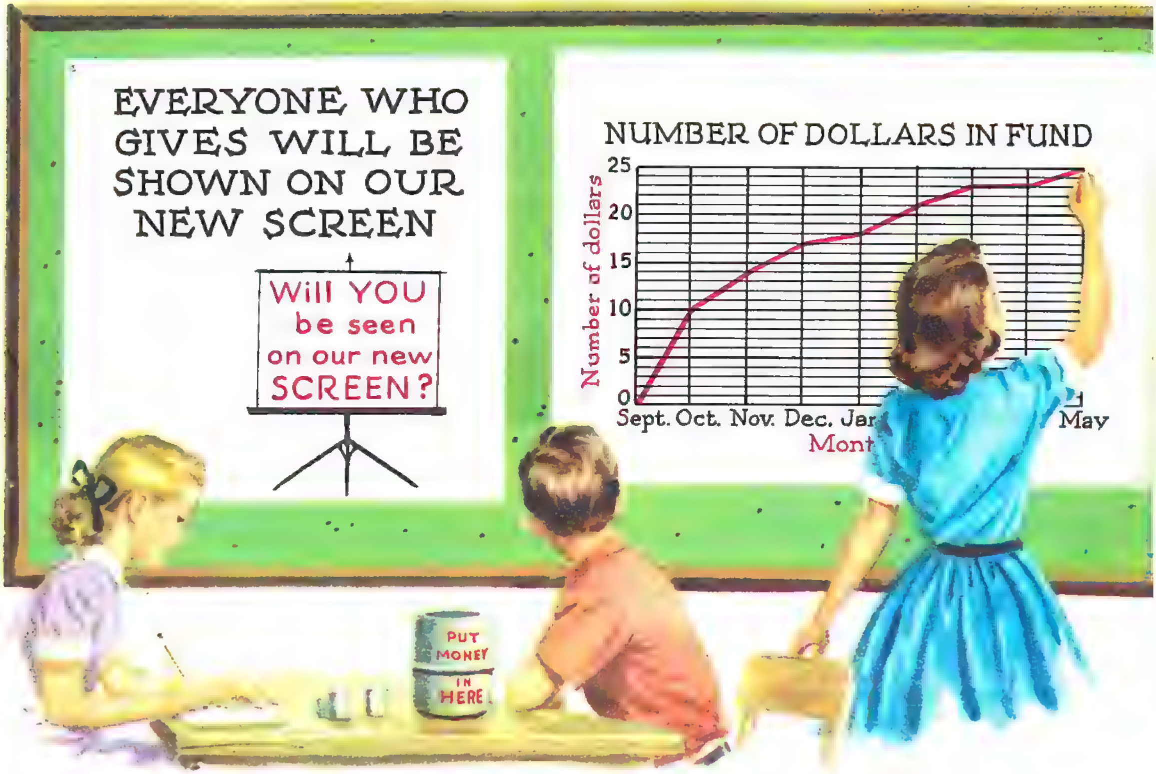
Roosevelt	12
Wilson	10
Washington	16
Lincoln	17

4. In a high jump contest six seventh-grade boys made these records.

Make a bar graph to show the height of each boy's jump in inches.

Joe	2′11″
Bill	3′ 4″
Tom	3′ 1″
Ray	2′10″
Bob	3′ 6″
Ted	3′ 0″

To the Teacher: See Note 3 on page 303.



Reading a line graph

The students of the Park School earned money and brought it to school for a fund to buy a portable moving-picture screen.

This *line graph* shows how the fund grew. It shows the total that had been turned in by the beginning of each month after school opened.

1. Explain the *vertical scale.* What does each unit on the vertical scale represent?

2. Why does the vertical scale begin at zero for Sept. 1?

3. What does each unit on the *horizontal scale* represent?

4. How much had been brought in by Oct. 1? by Nov. 1?

5. Read the graph for each of the other months.

6. In which month was the most money brought in? Explain how you could tell just by looking at the slant of the line.

7. In which month was no money brought in? Note that the line here is horizontal.

8. How much money was brought in during December? during January? during February?

Record of Jim's tests

Jim White and his class were studying fractions. Jim studied and practiced and took a test once a week for 10 weeks. Each test had 50 examples.

This line graph shows his test records for those weeks.

The red line shows the number of examples Jim tried to do. The black line shows the number he did correctly.

1. The first week Jim hurried. He tried _?_ examples but did only _?_ correctly.

2. The second week the number of examples tried was _?_ and the number of examples correct was _?_.

3. At the end of the _?_ week, Jim had 45 examples correct out of the same number tried.

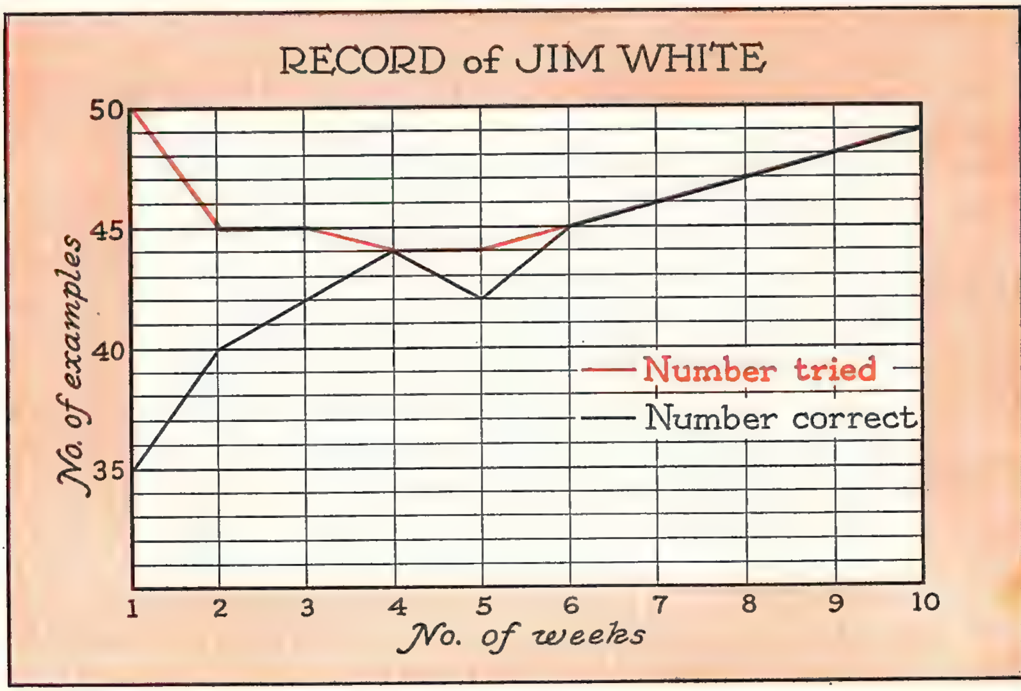
4. He tried _?_ examples in his test at the end of the fifth week and had _?_ examples wrong.

5. From the _?_ week on, he had all the examples he tried correct.

6. In ten weeks Jim's record of number right increased from _?_ examples to _?_ examples.

7. At the end of the tenth week the number right was _?_ examples.

8. Why do you suppose the vertical scale does not start at 0?



Making line graphs

Mary Jones has been practicing typewriting. Her progress during ten trials is shown in this table:

TRIAL	AVERAGE NUMBER OF CORRECT WORDS PER MINUTE
1st	10
2nd	12
3rd	12
4th	13
5th	15
6th	14
7th	16
8th	16
9th	18
10th	19

Mary wants to make a line graph to picture her progress.

- She plans to show "Number of Trial" on the horizontal scale and "Average Number of Correct Words Per Minute" on the vertical scale. Is that a good idea?
- The horizontal scale will show _?_ trials. It should run from 1 to _?_.
- The vertical scale should run from 10 to a little more than _?_.
- What would be a good title for her graph?
- Did Mary improve continuously?

1. Make the graph referred to above.

2. Ellen kept this record of the weight in pounds of her baby brother for his first 8 months.

Months	1	2	3	4	5	6	7	8
Pounds	7	9	12	13	14	14	15	16

Ellen now wants to make a graph to show the baby's increase in weight.

She plans to show "Age in Months" on the horizontal scale and "Weight in Pounds" on the _?_ scale.

- The horizontal scale will show a total of _?_ months. It should run from _?_ to _?_.
- The vertical scale should run from _?_ to _?_.
- What would be a good title for the graph?

3. Make a line graph, to show "Baby Brother's Weight for First Eight Months." (Ex. 2)

4. The table below shows Betsy Smith's height in inches each year from the age of 10 to 17 years. Make a line graph to show the data contained in the table.

Years	10	11	12	13	14	15	16	17
Inches	53	55	57	59	61	62	63	63

5. Bring to class some line graphs you find in newspapers and magazines. Discuss them.

The meaning of multiplication

1. Jane went to the store to buy 12 pineapples at 15 cents each.

To find their cost, Jane thought:

▶ 10 × 15 cents is 150 cents.

▶ 2 × 15 cents is 30 cents.

▶ So 12 × 15 cents is 150¢ + 30¢, or _?_ ¢.

2. The storekeeper (see Ex. 1) figured the cost this way:⟶ How was his thinking different from Jane's?

$$\begin{array}{r} 15\text{¢} \\ \times\ 12 \\ \hline 30 \\ 15 \\ \hline 180\text{¢} \\ \text{or } \$1.80 \end{array}$$

In this example 15¢ is multiplied by 12. Write 15¢ twelve times in a column and find the sum.

You will get 180¢ just as you did when you multiplied 15¢ by 12. Multiplying 15¢ by 12 is a short way of repeating 15¢ twelve times.

In this example the *15 cents is repeated 12 times.* The number that is repeated (15 cents) is the *multiplicand.* The number that tells how many times the 15 cents is to be repeated (12) is the *multiplier.* The result obtained (the 180 cents) is the *product.*

3. To find the cost of 15 pineapples at 12 cents each, Jane would think:

▶ 10 pineapples would cost 10 × 12 cents, or 120 cents.

▶ 5 more pineapples would cost 5 × 12 cents, or 60 cents.

▶ So 15 pineapples at 12 cents each would cost _?_ ¢ + _?_ ¢, or _?_ ¢.

4. Which of these three ways of figuring the cost of 15 pineapples at 12 cents each do you like best? Which agrees with Jane's thinking?

a	*b*	*c*
$\begin{array}{r} 12\text{¢} \\ \times\ 15 \\ \hline 120 \\ 60 \\ \hline 180\text{¢} \end{array}$	$\begin{array}{r} 12\text{¢} \\ \times\ 15 \\ \hline 60 \\ 120 \\ \hline 180\text{¢} \end{array}$	$\begin{array}{r} 12\text{¢} \\ \times\ 15 \\ \hline 60 \\ 12 \\ \hline 180\text{¢} \end{array}$

Do you know why most people prefer the third way when using pencil and paper?

5. In Ex. 4, what is the multiplicand? the multiplier? the product?

6. Exs. 1 and 3 show you that 12 × 15 cents means something quite different from 15 × 12 cents, but the products are alike. Can you explain?

7. How are these multiplications alike? different?

\$4	⟵ multiplicand ⟶	\$75
× 75	⟵ multiplier ⟶	× 4
?	⟵ product ⟶	?

8. Each time Tom went to the movies he spent 25 cents. One year he went 12 times, and spent _?_ cents.

9. In Ex. 8, did Tom spend 25 × 12 cents, or 12 × 25 cents?

10. In Ex. 8, what is the multiplicand? the multiplier? the product?

To the Teacher: See Note 1 on page 303.

Multiplying mentally

1. How do you find 10 × any whole number? How do you find 100 × any whole number? How do you find 1000 × any whole number? Illustrate each case.

2. To find 20 × 18, Mary thinks:⟶ Can you tell what rule Mary is using?

	a	*b*	*c*	*d*	*e*
3.	20 × 2	20 × 12	20 × 15	20 × 25	30 × 50
	30 × 5	30 × 12	30 × 15	30 × 25	40 × 50
	40 × 6	40 × 12	40 × 15	40 × 25	50 × 60

4. To find 8 × 27, George thought: 8 × 20 = 160; 8 × 7 = 56; so 8 × 27 = _?_ + _?_ = _?_.

5.	8 × 23	9 × 18	6 × 18	7 × 34	7 × 16
	8 × 34	9 × 26	6 × 28	8 × 46	8 × 27
	8 × 42	9 × 37	6 × 37	9 × 54	6 × 75
	8 × 57	9 × 45	6 × 49	6 × 82	8 × 59

6. To find 8 × 506, George thought: 8 × 500 = 4000; 8 × 6 = 48; so 8 × 506 = 4048. Was he right?

7.	6 × 305	5 × 307	6 × 906	6 × 505	4 × 607
	7 × 409	6 × 704	6 × 609	7 × 807	5 × 708
	8 × 504	7 × 609	7 × 908	8 × 904	6 × 809
	9 × 206	8 × 706	7 × 809	7 × 607	7 × 906

8. George found 21 × 16 by thinking: 20 × 16 = 320; 1 × 16 = 16; so 21 × 16 = _?_.

9. Mary found 21 × 16 by thinking: 21 × 10 = 210; 21 × 6 = 126; so 21 × 16 = _?_. Whose way do you prefer?

10.	21 × 15	12 × 13	14 × 15	12 × 34	19 × 42
	22 × 12	15 × 16	16 × 32	13 × 21	17 × 54
	13 × 25	18 × 15	41 × 12	14 × 18	37 × 16
	12 × 41	12 × 36	52 × 11	15 × 26	18 × 76

Practice in multiplication

Copy, multiply, and check by going over your work:

	a	b	c	d	e	f
1.	98 × 30	79 × 40	87 × 60	89 × 70	98 × 70	79 × 80
2.	87 × 69	78 × 96	68 × 79	86 × 97	98 × 89	89 × 97
3.	809 × 76	908 × 67	807 × 89	600 × 79	700 × 89	800 × 97
4.	789 × 800	879 × 700	978 × 800	879 × 89	987 × 89	798 × 98

5. In studying the multiplication at the right, Bill Roe said that the first *partial product* is 7 × 789, or 5523. Was he right?

6. Bill said that the second partial product, 4734, is really 47,340. Explain.

7. Bill explained that the third partial product, 6312, is really 631,200, because it is 800 × 789. Do you agree?

$$\begin{array}{r} 789 \\ \times\ 867 \\ \hline 5523 \\ 4734 \\ 6312 \\ \hline 684063 \end{array}$$

Copy and multiply:

	a	b	c	d	e	f
8.	789 × 678	698 × 789	798 × 987	768 × 907	879 × 807	978 × 907
9.	908 × 948	907 × 856	809 × 706	708 × 607	967 × 708	709 × 608

Tell which is larger:

	a	b	c
10.	10 × 125, or 1200	10 × 16, or 159	10 × 94, or 900
11.	100 × 39, or 4000	100 × 21, or 2000	100 × 387, or 4000
12.	1000 × 41, or 5000	100 × 98, or 10,000	1000 × 53, or 5400

Picturing division

Choose the diagram which shows the thinking you do to find each answer in Exs. 1–8.

DIAGRAM 1

DIAGRAM 2

1. How many 3-cent stamps can you buy for 12 cents? 4.

2. How many 4-cent erasers can you get for 12 cents? 3

3. How many groups of 4 boys can you get from 12 boys? 3

Here a group of 12 boys is to be divided into equal groups of a given size, 4 boys in each group. You need to find the number of the equal groups.

> **Use division to find the number of equal groups of a given size into which another group can be divided.**

4. If 3 boys share 12 cents equally, how many cents will each boy get? 6 cents

5. If 4 boys share 12 cents equally, how many cents will each boy get?

6. If you divide 12 into 4 equal groups, how many will there be in each group?

7. If you divide 12 into 3 equal groups, how many will there be in each group?

8. Four students wanted to share 12 apples equally. To find how many apples each should get, you divide _3?_ by _4?_.

In this problem there is a large group of 12 apples, to be divided into 4 equal groups. You are to find the size of the equal groups.

> **Use division to find the size of the equal groups into which another group is divided.**

9. How many groups of 5 each are there in a group of 30?

10. How many groups of 6 each are there in a group of 30?

11. $\frac{1}{6}$ of 30 = _?_ $\frac{1}{5}$ of 30 = _?_

In Exs. 12–14 tell whether you are finding the number of equal groups or the size of the equal groups into which a number is divided.

12. If 20 pennies are shared equally by four students, each student will get _5?_ pennies.

13. For 20 cents you can buy _10?_ two-cent stamps.

14. At 8 cents a pound you can buy _?_ pounds of sugar for 40 cents.

Understanding division

1. In the division example below, what is the *dividend?* the *divisor?* the *quotient?* the *remainder?*

```
divisor                        Check
  ↓   17 ← quotient              17
25)437 ← dividend              × 25
   25                            85
   187                          34
   175                          425
    12 ← remainder             + 12
                                437
```

2. How is a division checked?

3. How many 24's are there in 2956? More than 100? than 200?

```
A      2956
     − 2400  (100 × 24)
        556
     −  480  (20 × 24)
         76
     −   72  (3 × 24)
          4
```

- In Box A you see that one hundred 24's from 2956 leaves __?__.
- Are there more than ten 24's in 556? more than 20? as many as 30?
- Twenty 24's from 556 leaves __?__.
- How many 24's can you take from the 76? The remainder is __?__.
- In all you subtracted how many 24's? (100 + 20 + 3 = __?__.) Your work shows that 2956 ÷ 24 = 123, with a remainder of 4.

4. Another way to find how many 24's there are in 2956 is shown in Box B.

```
B      123
   24)2956
      2400
       556
       480
        76
        72
         4
```

- The 1 in hundreds place in the quotient shows that one hundred 24's are to be subtracted from 2956. 100 × 24 = __?__. 2956 − 2400 = __?__.
- The 2 in tens place in the quotient shows that twenty 24's are to be subtracted from 556. 20 × 24 = __?__. 556 − 480 = __?__.
- The 3 in units place shows that three 24's are to be subtracted from 76. 76 − 72 = __?__.
- All together, in 2956, there are __?__ 24's, with a remainder of __?__.

5. In dividing 2956 by 24, most students prefer the method shown in Box C. Explain it.

Copy the division without the work. Divide. Then see if your work is correct.

```
C      123
   24)2956
      24
       55
       48
        76
        72
         4
```

6. Which of the three methods of finding how many 24's there are in 2956 is easiest to understand? to do?

7. When you express the remainder as a fraction, what is the answer to the division in Ex. 1? in Box C?

To the Teacher: See Note 1 on page 303.

Estimating quotients

1. How many figures will there be in the quotient of this division: $6\overline{)564}$?

▶ Are there as many as 100 sixes in 564? $100 \times 6 =$? .

▶ Are there as many as 10 sixes in 564? $10 \times 6 =$? .

▶ How do you know the quotient is a 2-figure number?

2. How many figures will there be in the quotient of this division: $26\overline{)3432}$?

▶ Are there more than 100 twenty-sixes in 3432? Explain.

▶ Are there as many as 1000 twenty-sixes in 3432? Why not?

▶ Is the quotient a 3-figure or a 4-figure number? Explain.

3. If the dividend is less than 10 times the divisor can the quotient be a 2-figure number? Explain.

Without doing the division, tell whether each quotient in Exs. 4–8 is a 1-figure, 2-figure, 3-figure, or 4-figure number.

	a	*b*	*c*
4.	$8\overline{)472}$	$9\overline{)6275}$	$7\overline{)8056}$
5.	$8\overline{)2286}$	$29\overline{)11948}$	$39\overline{)7566}$
6.	$76\overline{)228}$	$28\overline{)2296}$	$49\overline{)2303}$
7.	$83\overline{)7304}$	$35\overline{)470}$	$91\overline{)8827}$
8.	$36\overline{)180}$	$26\overline{)351}$	$16\overline{)904}$

9. To find the first figure in the quotient in $8\overline{)472}$, Leo thought:

▶ The quotient is a 2-figure number.

▶ The figure in tens place may be 1, 2, 3, 4, 5, 6, 7, 8, or 9.

▶ 50×8 is less than 472; 60×8 is more than 472. So the first figure in the quotient is ? .

To find the first figure in the quotient in $8\overline{)472}$ most students would divide 47 by 8. By this method the first quotient figure is ? .

10. How would you find the first quotient figure in $29\overline{)11948}$?

▶ The quotient is a 3-figure number.

▶ The figure in hundreds place may be 1, 2, 3, 4, 5, 6, 7, 8, or 9.

▶ Are there more than 100 twenty-nines in 11948? more than 300? 400?

▶ The first quotient figure is ? .

Most students would try to find the first quotient figure by dividing 120 by 30 or 12 by 3. Explain.

11. Estimate the quotient in each division in Exs. 4–8. In Ex. 4*a* say, "The quotient is *50-some*"; etc.

12. Divide and check Exs. 4–8.

Estimate each quotient in Exs. 13–14. Then divide and check.

	a	*b*	*c*
13.	$36\overline{)3820}$	$85\overline{)17017}$	$47\overline{)2303}$
14.	$38\overline{)1387}$	$79\overline{)6794}$	$56\overline{)3248}$

 To the Teacher: See Note 4, on page 303.

Three-place divisors

1. The ticket committee wanted to sell 3600 tickets for the school play. How could they divide the tickets equally among 183 students?

```
     19
183)3600
    183
    1770
    1647
     123
```

- Are there more than ten 183's in 3600? How can you tell?
- Are there as many as twenty 183's in 3600? How can you tell?
- How do you think the class got the second quotient figure, 9?
- In 3600 there are _?_ 183's with a remainder of _?_. Prove it.
- After everyone had 19 tickets, how many students could take another?

2. Are there as many as ten 497's in 5807? How can you tell? Do the division.

497)5807

3. Are there as many as ten 285's in 27,940? as many as one hundred? How can you tell?

285)27,940

Will the quotient be a 1-figure or a 2-figure number? Do the division.

4. Tom said he could see at once that the quotient in this division is a little more than 100. How could he tell that? Do the division.

792)80,362

5. Is the quotient in this division nearer 100 or 1000? Is it more or less than 1000? How can you tell? Do the division.

319)318,964

6. Is the quotient in this division a 2-place or a 3-place number? Do the division.

392)40,000

Estimate the first quotient figure in each of the following, and tell how many figures there will be in the quotient:

7. 196)1897 203)20,000

8. 298)30,569 495)489,760

9. Would you estimate the quotient of 17,235 divided by 346 to be about 5, or 50, or 500? Explain.

10. John was asked to divide 16,583 by 721. He did it this way:

```
          3 }
         20 } = 23
721)16583
    14420
     2163
     2163
```

John's answer is _?_. Can you explain his work?

Do the division by the method you usually use.

How are the two methods alike? different?

Practice in division

In Exs. 1–6 you are to do the following four things:

Tell whether the quotient is a 1-figure, a 2-figure, a 3-figure, or a 4-figure number.

Estimate the first figure in the quotient.

Estimate the whole quotient. In Ex. 1a say, "The quotient is 20-some"*; in Ex. 1b say, "The quotient is* 300-some,*" and so on.*

Finally divide and check.

	a	*b*	*c*	*d*	*e*
1.	33)693	21)7245	22)832	42)1388	94)846564
2.	63)4662	62)5890	36)7814	73)14892	275)84632
3.	25)5075	42)8652	45)90135	36)367	48)$298.96
4.	52)2236	45)13945	84)7944	28)1729	75)$295.50
5.	59)4956	27)83421	43)2976	17)19525	143)13796
6.	76)8134	37)9421	53)2766	49)4165	436)95264

7. If Agnes buys towels at $4.50 a half dozen, how much does she pay for each towel?

8. It took Art's father 7 hours to travel 266 miles. That means that he was traveling at an average rate of __?__ miles an hour.

9. At $135 an acre, how much did George's uncle pay for a field that contains 3200 square rods? (160 sq. rd. = 1 acre.)

10. Mr. Mathers' car travels 18 miles on one gallon of gasoline. To travel 700 miles, how many whole gallons of gasoline does Mr. Mathers need to buy?

11. The Bixby family's milk bill last week was $2.94. That was an average of __?__ cents a day.

12. The cost of a yearly subscription for a magazine that is published monthly is $5.50. Is that nearer 45 or 46 cents per copy?

13. The total weight of the 12 seventh grade boys on the Jones School basketball team is 1051 lbs. The average weight of the players is __?__ pounds.

14. A jet plane flew 365 miles from Toronto to New York in 59 minutes. How many miles per minute did it average to the nearest mile?

Finding missing numbers

1. If you know that $5 \times 9 = 45$, then you know that $45 \div 5 = \underline{\ ?\ }$, and $45 \div 9 = \underline{\ ?\ }$.

2. How do you find what number N stands for in $N \times 9 = 45$? in $5 \times N = 45$?

3. If you know that $8 \times 5 = 40$, then you know that $40 \div 5 = \underline{\ ?\ }$, and $40 \div 8 = \underline{\ ?\ }$.

4. Some number multiplied by 5 equals 40. What do you do to find the number? Do you see that the number is $40 \div 5 = \underline{\ ?\ }$?

5. If $5 \times N = 40$, then $N = 40 \div \underline{\ ?\ } = \underline{\ ?\ }$.

6. If 6 times a number is 24, then the number is $24 \div 6 = \underline{\ ?\ }$.

7. If $6 \times N = 24$, then $N = \underline{\ ?\ }$.

8. A certain number divided by 5 equals 10. What do you do to find the number? Do you see that the number is 10×5?

9. If a number divided by 3 is 7, then the number is $7 \times \underline{\ ?\ } = \underline{\ ?\ }$.

10. If $N \div 4 = 3$, then $N = 3 \times \underline{\ ?\ } = \underline{\ ?\ }$.

11. If $N \div 7 = 2$, then $N = 2 \times \underline{\ ?\ } = \underline{\ ?\ }$.

12. If $N \div 5 = 4$, then $N = 4 \times \underline{\ ?\ } = \underline{\ ?\ }$.

Find what number N stands for in each of the following:

	a	*b*
13.	$5 \times N = 30$	$N \div 2 = 8$
14.	$8 \times N = 56$	$N \div 7 = 3$
15.	$N \times 4 = 36$	$N \div 6 = 5$
16.	$N \times 6 = 42$	$N \div 7 = 4$
17.	$N \times 7 = 63$	$N \div 8 = 5$
18.	$N \times 20 = 80$	$N \div 3 = 5$
19.	$10 \times N = 150$	$N \div 6 = 24$
20.	$N \times 12 = 36$	$N \div 5 = 15$
21.	$N \times 9 = 27$	$N \div 4 = 3$
22.	$11 \times N = 121$	$N \div 9 = 27$

23. $N \div 3 = 5$ can be written $\frac{N}{3} = 5$. What number is N?

24. In $\frac{N}{3} = 5$, the dividend is N, the divisor is 3, and the quotient is 5. How can you find an unknown dividend when you know the divisor and the quotient?

25. In $5 \times N = 30$, the multiplier is 5, the multiplicand is N and the product is 30. How can you find an unknown multiplicand when you know the multiplier and the product? If $5 \times N = 30$, then $N = \underline{\ ?\ }$.

26. If $N \times 4 = 28$, how do you find the unknown multiplier N?

To the Teacher: See Note 5 on page 303.

Estimating answers

1. Tom wanted to estimate the sum of these four numbers:

897 1236 27 1871

Tom rounded off the numbers:

NUMBERS	ROUNDED TO 100'S
897 →	9 hundred
1236 →	12 hundred
27 →	0 hundred
1871 →	19 hundred
?	? hundred

Tom added this way: 9 hundred, 21 hundred, _?_ hundred.

Compare the estimated sum with the exact sum.

If Tom had rounded off to thousands, his estimated sum would have been _?_.

2. To estimate the difference between 1325 and 497, think:

13 hundred less 5 hundred is _?_ hundred. Compare the estimated difference with the exact difference.

3. To estimate the product of 32×18, think:

32 is about 30; 18 is about 20; so 32×18 is about 30×20, or 600.

Do you see why each of the numbers was rounded to tens? Compare the estimate with the exact product.

4. To estimate the quotient of 2795 divided by 398, think:

28 hundred divided by 4 hundred is 7. Compare the estimate with the exact quotient.

Estimate the following (round off to hundreds). Then compare each estimate with the exact answer.

5.
$$\begin{array}{r} 798 \\ 87 \\ 123 \\ \underline{12} \end{array}$$

6.
$$\begin{array}{r} 1423 \\ 880 \\ 56 \\ \underline{452} \end{array}$$

7.
$$\begin{array}{r} 1296 \\ \underline{-\ 708} \end{array}$$

8. 97×205

9. $3589 \div 584$

10. The sum of 492 and 9012 and 8 is about _?_ hundred. The exact sum is _?_.

11. Is a five-dollar bill enough to pay for purchases of $1.25, $2.50, and $1.98? Find your answer by estimating. Explain your thinking.

12. The difference between 1789 and 395 is about _?_ hundred. The exact difference is _?_.

13. If you buy an article for $3.98 and hand the clerk a ten-dollar bill, about how much should you receive in change?

14. The product of 43 and 18 is about _?_ hundred. The exact product is _?_.

15. If you buy 9 baseball uniforms for $5.98 each, about how much money do you need? Exactly how much?

16. The quotient of 7192 divided by 798 is about _?_. The exact quotient is _?_.

To the Teacher: See Note 6 on page 303.

Estimating in problem solving

Read each problem slowly and carefully. Then estimate the answer.

1. Mrs. Chase bought a cotton dress for herself for \$7.98 and a "look-alike" dress for her daughter, Ann, for \$4.98. How much did she pay for the two dresses?

Explain how you could estimate the cost quickly. Could you get the answer this way: \$8.00 + \$5.00 − \$.04?

2. A chair in Jane's room needed a new slip cover. Mrs. Miller bought 5 yards of chintz at 59¢ a yard and made the cover herself. How much did the chintz cost?

Could you get the answer this way: 5 × \$.60 − \$.05? Explain.

3. The Big Town Girl Scouts hoped to sell 50,000 boxes of cookies in their yearly sale. The final reports showed these orders:

Troop 1	8,785 boxes
Troop 2	11,280 boxes
Troop 3	10,595 boxes
Troop 4	20,600 boxes

How many boxes of cookies were ordered? (Before doing the example, make a quick estimate to see if the Girl Scouts reached their quota of 50,000 boxes.)

4. A plane made a non-stop flight of 9600 miles without refueling. It flew for 24 hours 55 minutes. Estimate the average speed of the plane during the non-stop flight.

5. Bert Ray has just picked 5 bushels of nuts. From one bushel of nuts he fills 32 bags. His father will sell them in the city at 30¢ a bag.

How much will his father receive if he sells all the nuts? Would this be a good estimate: $5 \times 30 \times \$\frac{1}{3}$? Explain.

6. Mr. Ray (Ex. 5) pays Bert \$2 a bushel for picking the nuts. How much will Mr. Ray have left for himself after selling 5 bushels of nuts? Make a quick estimate.

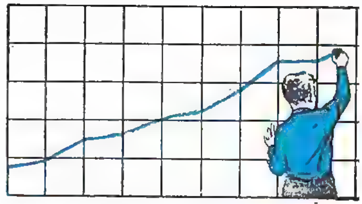
7. The population of Topfield in 1950 was 149,554. It is expected that the next census will show about 168,000. What is the increase to the nearest thousand? (Can you do this mentally?)

8. A fast train went 907 miles in 16 hours. About how fast is this? Think: 900 ÷ 15 = _?_.

9. In the auditorium in the Prescott School there are 31 rows of seats with 18 seats in each row. Estimate the number of persons who can be seated in the auditorium.

10. Philip says that it is a 7-hour trip by automobile from his home to Round-Up Ranch. Would you estimate the distance to be about 100 miles, 350 miles, or 700 miles? Explain.

Measuring your growth in arithmetic



▶Test 1a

1. If ten men were absent from a factory employing 2000 men, how many men were present?

2. 1000 miles is how much greater than 100 miles? 1000 miles is how many times as great as 100 miles?

3. A recent report stated that there are 783,653 miles of railroad in the world and that the Americas have 355,536 miles. What are these numbers, rounded to the nearest 100,000?

4. In Ex. 3 is the mileage in the Americas about $\frac{2}{3}$, $\frac{1}{2}$, or $\frac{1}{4}$ of the total world mileage?

5. Write $\$4\frac{1}{2}$ billion, using figures.

6. How much change would you get from 6 ten-dollar bills after paying for two automobile tires at $21.98 each, for 10 gallons of gasoline at 24 cents a gallon, and $12.42 for repair service?

Add 6 to each number:

7. 3 13 23 33 43

8. 8 18 28 38 48

9. Subtract 8 from each of these numbers:

13 33 53 73 93

10. If a bar 2 inches long represents 1,000,000 bushels of wheat, a bar 3 inches long represents ___?___ bushels.

▶Test 1b

1. Write $3,500,000 in two other ways.

2. Write MCMIX in figures.

3.
```
 59478
  6008
 95032
   947
  8997
```

4.
```
 9056
× 76
```

5.
```
 789
× 500
```

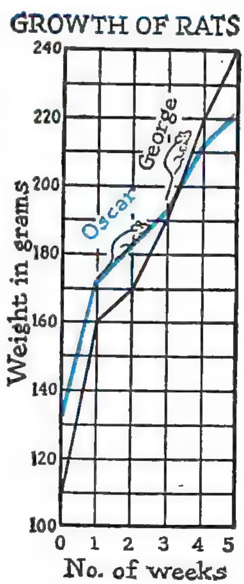
6.
```
  97456
− 30965
```

7.
```
  70000
− 62895
```

8. 32)3008

9. 69)4002

10. Refer to the graph.
- Which rat weighed more at the beginning? at the end?
- How much did George gain each week?
- At the ___?___ weighing, both rats weighed the same.
- When did George gain the least? the most?



Miles to nearest 10		
FROM	TO	
New York	London	3480
London	Brussels	200
Brussels	Frankfort	200
Frankfort	Istanbul	1170
Istanbul	Beirut	640
Beirut	Basra	770
Basra	Karachi	1250
Karachi	Delhi	690
Delhi	Bangkok	1830
Bangkok	Hong Kong	1100
Hong Kong	Tokyo	1800
Tokyo	Wake Island	1990
Wake Island	Honolulu	2550
Honolulu	San Francisco	2390
San Francisco	New York	2580

Around the world

1. This map shows one of the routes that passenger planes fly on regular trips around the world.

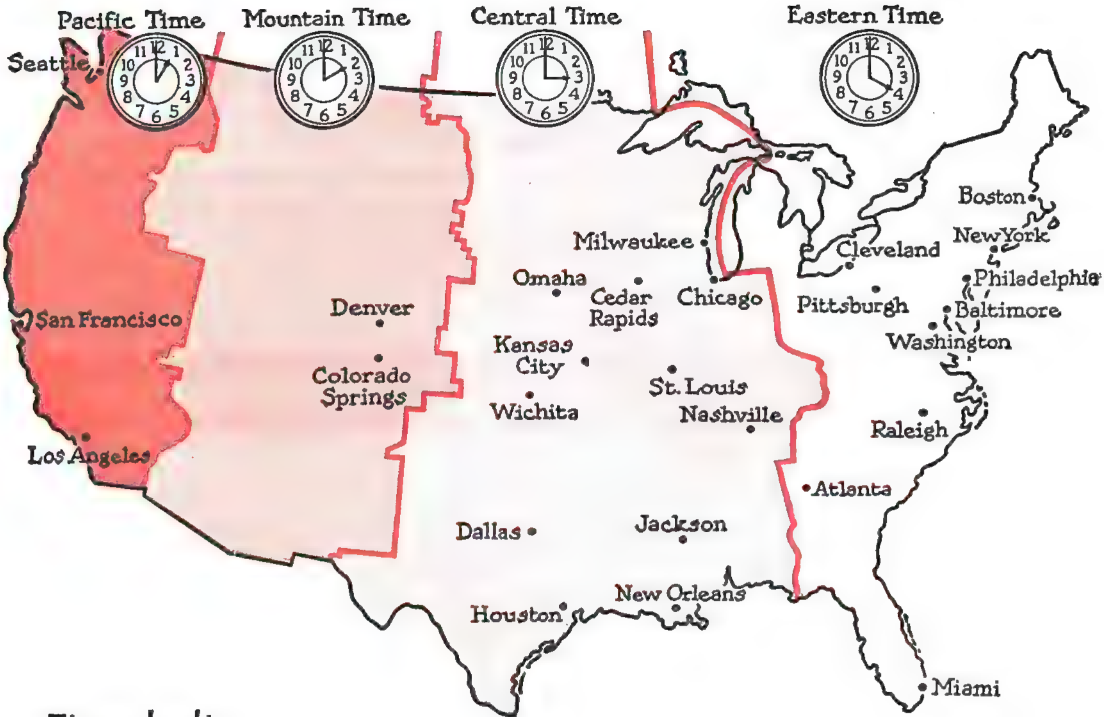
The plane flies east from New York and follows the route shown by the blue line on the map. Trace the route of the plane on a globe.

2. The cities and islands where the plane makes regular stops are shown on the map by dots, as ⊙ Basra. In the table above the air line distances between stops are given. What is the total number of miles flown?

3. On one of the regular flights over this route a passenger can travel around the world in approximately six days. What is the average number of miles traveled each day to the nearest whole mile?

4. What is the average speed of the plane per hour, assuming a six-day trip with 40 hours on the ground?

5. From Honolulu to San Francisco the plane flies non-stop over the ocean in 9 hours 15 minutes. What is the average speed over the ocean?



Time belts

Before 1883 all towns and cities used *local*, or *sun*, time. Noon at any place was the instant the sun crossed a north-and-south line through that place. Between one city and another to the east or west the difference in time might have been 21 seconds, or 5 minutes, or $2\frac{1}{2}$ hours, depending on the distance.

Imagine the confusion today in trying to use a railroad or an airplane timetable under such a system!

To avoid such confusion, Standard Time Belts have been set up all over the world. Within one of these time belts all places use the same time, called the *standard time* for that belt. From one time belt to the next, there is a difference of one hour.

Answer the following questions by looking at the map and the clocks:

1. As you cross the United States from East to West, the first time belt is called Eastern Time (ET), the second time belt is _?_ Time (CT), the third is _?_ Time (MT), and the fourth is Pacific Time (_?_).

2. The clocks indicate that when it is 4 o'clock ET, it is _?_ o'clock CT, _?_ o'clock MT, and _?_ o'clock PT.

3. There are _?_ hours difference between ET and PT.

When it is noon ET, it is _?_ o'clock in the morning PT.

4. When it is 5 P.M. in Philadelphia, it is _?_ P.M. in Boston.

5. If the President's message is broadcast from Washington, D. C., at 10:30 P.M., what time is it received in Colorado Springs? in Seattle? in all the cities on the Pacific coast? Explain.

Does your answer give you a hint as to why the President's talks generally are given at 10:30 P.M. Eastern Time?

6. The all-star baseball game is televised from Chicago at 2 P.M.

What time should you tune in at Baltimore? at Denver?

7. If you were flying from Cleveland to Omaha, you would set your watch _?_ hour _?_ (backward or forward) when you reached Omaha. Explain.

8. If you were flying from Denver to Cedar Rapids, you would set your watch _?_ hour _?_ (backward or forward) when you reached Cedar Rapids. Explain.

9. The open golf tournament is broadcast from Pittsburgh at 4 P.M. What time is it received in Milwaukee? Kansas City? Houston? New Orleans? Explain.

10. You have heard broadcasts of football games from the Rose Bowl in California.

If you live in Atlanta, at what time will you get a 2:00 P.M. broadcast of the game? If you live near Wichita, at what time will you get the broadcast?

11. When a plane leaves New York City for San Francisco at 8:00 A.M., what time is it in San Francisco at that minute?

12. If you live near St. Louis, at what time should you tune in a boxing bout that is broadcast from Miami at 10:00 P.M.?

13. Grace takes a plane at 8 o'clock (CT) in Chicago to fly to New York.

The plane makes a non-stop flight in 2 hours 55 minutes. At what time (ET) will Grace reach New York?

14. Mr. Blair and Tom drove from Nashville to Los Angeles. How many times did they have to change their watches to keep standard time?

At 6:30 P.M. they telephoned from Los Angeles to Nashville. What was the time at their home in Nashville?

15. George Barnes lives in Raleigh, N. C. For the past 3 weeks his father has been working in Denver.

At 6 P.M., Mrs. Barnes telephoned her husband's hotel, but was told that Mr. Barnes would not be in until 6:30 P.M. How long should she wait before calling again?

16. Mary Knowles lives in Omaha, but is visiting her grandmother in Baltimore. Omaha is on standard time, but Baltimore is on "daylight saving" time. If Mary's mother telephones from Omaha at 7:30 P.M., what time is it in Baltimore?

If necessary, have your teacher explain daylight saving time.

Air travel

Light face type indicates A.M.
Dark face type indicates P.M.

SCHEDULES—WESTBOUND

Table 27	621	617	633	627	317	709	609	629	607	623	301	701	611	619	325
BOSTON ....(ET)Lv	....	....	....	8 00	....	....	....	....	....	....	....	....	....	....	**3 50**
HARTFORD–SPRINGFIELD Lv	....	....	....	9 00	....	....	....	....	....	....	....	....	....	....	**5 20**
NEW YORK															
(La Guardia Air.) ...Lv	8 00	6 10	....		9 30	....	12 00	....	....	**1 00**	....	....	....	**4 40**	....
(International Air.) ..Lv		—	....		—	12 00		....	....		....	**4 00**	....	—	....
(Newark Air.) Lv		—	....		—			10 10	....		**1 00**		....	—	....
PHILADELPHIA Lv		7 15	....		—			11 10	....		**1 55**		....	**5 40**	....
WASHINGTON.....Lv		—	....		—			—	**12 30**		—		**4 30**	—	....
CLEVELAND Lv		—	....		**12 15**			—	—		—		—	—	**8 25**
DETROIT............Lv		10 00	....		—			**1 55**	—		**4 50**		—	**8 25**	—
CHICAGO ......(CT)Ar	10 15	10 10	....	11 30	—		**2 15**	**2 05**	**2 10**	**3 15**	**5 15**		**6 10**	**8 35**	**9 15**
CHICAGO Lv	10 45	10 50	....	**12 10**	—		**2 45**	**2 50**	**2 55**	**3 45**	**5 40**		**6 40**	**9 20**	....
OMAHA Lv		—	....		**4 10**			—	**5 25**		**8 15**		—	12 05	....
DENVER........(MT)Ar		**1 35**	....	**2 55**	**5 45**			**5 35**	**6 35**		**10 55**	**7 30**	—	1 15	....
DENVER............Lv		**2 05**	**3 00**	**3 25**	**6 45**			**6 10**	**7 05**		....	**8 00**	—	....	....
LOS ANGELES ..(PT)Ar		**4 45**	—		—	**4 55**	**7 55**	—	**9 50**		....		—	....	....
OAKLAND ....Ar		....	**7 20**		1 50	....	....	—	....		....		—	....	....
SAN FRANCISCO ...Ar	**4 25**	....	**8 00**		2 15	....	....	—	....	**9 25**	....	**10 30**	12 20	....	....
SEATTLE ....Ar	....	....	....	**6 55**	....	....	....	**10 45**	....	....	....	....	....	....	....

This is part of an air timetable of one airline's coast-to-coast flights.

1. At what times do planes leave New York airports? Do all of these planes fly to the west coast? How do you tell the difference between A.M. and P.M.?

2. Why is it necessary to put (ET) in the row with Boston, (CT) with Chicago, (MT) with Denver, and (PT) with Los Angeles?

3. The numbers in the top row are the numbers by which the flights are known. For example, the plane leaving Boston at 8:00 is called Flight 627. At what places and at what time does Flight 627 stop?

In the above timetable there are no through flights listed between Boston and Los Angeles. If you flew to Chicago from Boston on Flight 627, what would you have to do to continue on to Los Angeles by air?

4. A passenger can leave New York on Flight 621 at 8:00 (ET) and arrive in San Francisco at **4:25** (PT). Does the flight take 8 hr. 25 min., 5 hr. 25 min., or 11 hr. 25 min.?

5. On Flight 621, the timetable shows a 30-minute stop in Chicago. The total time in the air is therefore _?_ hr. _?_ minutes. (See your answer to Ex. 4.)

6. Upon reaching Chicago the passengers on Flight 621 should change their watches from ET to CT. Should they set their watches forward or backward one hour?

7. Flight 621 is non-stop between Chicago and San Francisco. Before landing at San Francisco how should the passengers change their watches?

8. What flights can you take between Cleveland and Omaha?

9. Find another regular flight on the air timetable (opposite page) that takes the same time as Flight 621.

What is the number of the flight?

10. The airline distance between New York and Chicago is about 720 miles.

If a plane flies this distance in $3\frac{1}{4}$ hours, what is the average speed in miles per hour? (Give the answer to the nearest whole mile per hour.)

11. A one-way fare from Cleveland to Denver is $77.10.

If Mr. Hunt travels on Monday, Tuesday, or Wednesday and buys one full-fare ticket for himself, he can get each of the three tickets for Mrs. Hunt, Betty, and Ted for one half the full-fare price.

If purchased on any of the above days, what will these four tickets from Cleveland to Denver cost?

12. The government taxes all airplane fares within the United States. The tax is about 10¢ on each dollar of the fare.

The tax on the four fares (use $193) for the Hunt family's trip from Cleveland to Denver is $_?_.

What is the total cost of their trip by plane? (There is no expense for meals on these planes.)

13. By airmail, letters can leave Omaha at 3:45 P.M. and reach Philadelphia at 9:45 P.M.

Is the elapsed time 7 hr., 6 hr., or 5 hr.?

14. Railway time between Omaha and Philadelphia is about 18 hours.

Mail by this railway time would take _?_ times as long as by air. (Estimate the answer mentally to the nearest whole number. You will need to use your answer to Ex. 13.)

15. If fruit is sent by air express from Los Angeles at 8:00 A.M. on Monday, it reaches New York City at 9:00 P.M. Monday. 9:00 P.M. in New York is _?_ in Los Angeles.

How many hours does it take by air express from Los Angeles to New York?

Fruit shipped on Monday morning from Los Angeles can be offered for sale in the New York stores on _?_ morning.

16. If Mr. Ash leaves New York at 1:00 P.M. and reaches San Francisco $11\frac{1}{4}$ hours later, what time will it be in San Francisco?

17. When he returns, Mr. Ash can leave San Francisco at 11:45 A.M., stop for 35 minutes in Chicago, and reach New York at 11:30 P.M. How long in hours and minutes will be the actual flying time?

18. Merchants are shipping more and more of their goods by air express and air freight. You may be interested in finding out about the comparative cost of shipping by (1) air freight, railway freight, and motor truck, and (2) air express and railway express.

How do you find the answer?

In each exercise tell what you should do to find the answer. It may be helpful to make up simple numbers for each exercise.

1. You have a record of what you have earned each day for a month. How can you find your total earnings for that month?

2. You know you have earned the same amount each week for four weeks. How can you find the total amount you have earned in four weeks?

3. You know how much you earn each Saturday. How can you tell what you have earned when you have worked for 9 Saturdays?

4. You know how much you have earned each month during the year. How can you find the difference between what you earned in January and what you earned in December?

5. You know your height now and your height a year ago. How can you tell how much you have grown in a year?

6. The market price of one dozen oranges is given. How can you find what you must pay for 3 oranges?

7. You have bought several articles at the market. The clerk hands you a slip with the total cost. How can you check the correctness of this amount?

8. You know what 3 grapefruit cost. How can you find the cost of 6 grapefruit?

9. A bus timetable gives the time the bus leaves one city and the time it arrives at another. How can you find the length of time the bus takes for the trip?

10. You know the price of one gallon of gasoline. You know the tax on one gallon. How will you find the total cost of 10 gallons?

11. You know the number of pounds of tomatoes you have. You know that it takes $1\frac{1}{2}$ lb. to make 1 pint jar of canned tomatoes. How can you find the number of canning jars you will need?

12. You know the special price for 10 jars of marmalade. At the same rate what is the cost of one jar?

13. You know the number of bulbs you have planted. You know the number that have started to grow. How can you find what part the number growing is of the total number of bulbs?

14. A surveyor has measured the length of each side of a field. How can you find the number of feet of fencing needed to enclose the field?

One step at a time

1. Mrs. Andrews buys 3 quarts of milk every other day. The milk costs 25 cents a quart. She wants to find out how much the milk will cost for a 30-day month.

▶ The milk will be delivered on _?_ days during the month.

▶ Each delivery day the milk will cost $_?_.

▶ The cost per month is $_?_.

2. Mr. Bell bought 3 boxes of candles at $1.25 a box. There were 18 candles in each box. He sold them for 19¢ a pair. What was the difference between the selling price and the cost of the candles?

▶ The cost of the candles was _?_.

▶ The total number of candles in the three boxes was _?_.

▶ The candles were sold 2 at a time. So there were _?_ sales.

▶ The total selling price was _?_.

▶ The difference was _?_.

3. Grass seed is sold in 5-pound bags for $2.25. The directions read: "Use 1 pound for 125 square feet of lawn." How much will it cost to buy seed for a lawn 3000 sq. ft. in area?

▶ The number of square feet in the lawn is _?_.

▶ The number of 125's in 3000 is _?_.

▶ The number of pounds needed is _?_.

▶ The number of 5-pound bags needed is _?_.

▶ The cost will be _?_.

4. In a contest for model planes, the highest speed for the day was 125 miles per hour. How many feet per second did this model fly?

▶ 125 mi. per hr. is _?_ ft. per hr.

▶ This is _?_ ft. per min. or _?_ ft. per sec.

5. Mr. Raine pays $6.25 each month for 105 local telephone calls. Each additional call costs 5 cents. If he makes 200 calls in one month, what will be his telephone bill?

▶ The amount for 105 calls is _?_.

▶ The number of additional calls is _?_.

▶ The cost for these additional calls is _?_.

▶ The total bill is _?_.

6. The girls in the seventh grade cooking class made 135 dozen cookies to sell to raise money for the school student fund.

They sold the cookies in paper bags at 10 cents for 5 cookies. The girls' record of expenses showed that materials for every 5 dozen cookies cost 35 cents.

They bought sandwich bags in packages of 40 bags at 10 cents a package.

How much did the girls have for the student fund after the expenses were paid?

Do this problem one step at a time as you did the other problems on this page.

Information, please!

Before you can do these problems you need more information. Tell what information is missing and explain how you would do each problem.

1. If you buy a hat marked down $\frac{1}{2}$, what is the sale price of the hat?

2. How long does it take the Jones family to drive 80 miles from their house to their shore cabin?

3. When coal costs $21.70 a ton, what does it cost to heat a house during an average winter?

4. Bob has one-fourth of the lawn mowed. How long will it take him to mow the remainder of the lawn?

5. Lunch in the school lunchroom costs 25¢. How much is saved if you bring your lunch for five days?

6. Two bars of soap are sold together at a reduced price. What do one dozen bars cost?

7. How many 16-ounce loaves of bread are needed for picnic sandwiches for 20 people?

8. John is going by bus to Bill's house. At what time should he leave in order to reach there by 2:00 P.M.?

9. In how many hours will an airplane with 1900-horsepower engines fly 500 miles?

10. The corn crop this year is about $3\frac{1}{2}$ billion bushels. How many bushels per acre is that?

11. Richard is to make a scale drawing of his own yard, which is 100×50 ft. What length of line does he use for each dimension?

12. A new car is made with a short wheelbase to make parking in the city easier. How many of these cars could be parked closely along a 50-foot curb?

13. Mr. Adams walked 20 miles one Saturday. How many miles an hour did he walk?

14. On a long trip Frank's father bought 20 gallons of gasoline for his car. How many miles does the car travel on one gallon of gasoline?

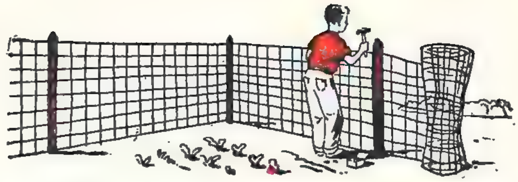
15. If a railroad ticket costs $4.85, what is the cost per mile?

16. The Brent family spent their vacation driving through the mountains. The expense for the whole vacation was $268. What was the average cost per day for their trip?

17. Sue has saved $7.50. How much more must she save to buy a raincoat?

18. James has been practicing riding his bicycle every day. How many miles can he ride in four hours?

Holding your ground



▶ Oral review

1. Add 9 to each number:

4 14 24 34 44 64 74 84 94

2. Add 9, 5, 3, 5, and 8.

3. Add 6, 7, 8, 5, 9, 4, and 6.

4. Subtract 7 from each number:

9 18 27 36 45 54 63 72 81

5. Mr. Myers has a balance of $42.22 in his bank. If he withdraws $28.75 how can he find what his new balance will be?

6. The Harringtons have saved $69.75 toward buying a 125-dollar radio. How can you find how much more money they need?

7. Joyce and her brother Morris are comparing their heights. Joyce is 4 ft. 11 in. tall and Morris is 5 ft. 4 in. tall.

How can you find how much taller Morris is than Joyce? How much taller is he?

8. What number is 1 more than 1000? How many figures does it take to write this new number?

9. What number is 1 less than 10,000?

10. Read this number: 23,650,070

11. Express to the nearest million:

125,284,317 3,726,000 24,562,475

12. To compare two numbers by finding how many times as large one number is as the other, should you add, subtract, multiply, or divide? Illustrate.

Divide:

13. $9\overline{)83}$ $8\overline{)53}$ $7\overline{)55}$ $6\overline{)47}$

14. $6\overline{)59}$ $8\overline{)62}$ $9\overline{)88}$ $7\overline{)24}$

15. In the division $26\overline{)10,478}$ is the quotient a 1-figure, 2-figure, or 3-figure number?

16. Is 23×32 equal to 2×32 plus 3×32, or 20×32 plus 3×32?

17. How much is 30×20?

18. If $5 \times N = 40$, what number does N stand for?

19. If $N \div 3 = 6$, what number does N stand for?

20. Is $789 + 95 + 123$ about 1000 or about 900?

21. What numbers between 50 and 100 can be divided by 8 without a remainder?

22. One can of frozen fruit juice costs 27 cents. It will make enough juice to serve 6 persons. How much will it cost for enough juice to serve 24 persons?

Holding your ground

▶ Written review

Add:

1. 14235	**2.** 26734	**3.** 49376	**4.** 85516	**5.** 95434
85324	63254	78217	38442	93619
			46116	40913

Subtract:

6. 61212	**7.** 87306	**8.** 39118	**9.** 85000	**10.** 60500
53036	83960	7379	61426	43502

Multiply:

11. 48×78 **12.** 85×36

Divide:

13. $21\overline{)7266}$ **14.** $63\overline{)4788}$

15. If there are 144 sheets in a package of paper, how many sheets would there be in 25 packages?

16. Mr. Robertson covered 7684 miles in driving 29 days. How many miles to the nearest whole mile did he travel on the average in one day?

17. Write in figures: sixteen thousand, four hundred sixty dollars and thirteen cents.

18. Write in figures: MCMXLIX.

19. A radio marked $98.50 was reduced to $74.98. How much was the reduction?

20. A plane left New York City at 7 A.M. (ET) and arrived in Los Angeles at 5 P.M. (PT). How many hours was it on the way?

21. Find the sum of 53,674 and 9456.

22. Find the product of 864 and 503.

23. The dividend is 11,628 and the divisor is 38. What is the quotient?

24. What number multiplied by 26 will give 2354?

25. What number added to 6742 will give 6974?

26. 124 exceeds 72 by __?__.

27. How much greater than 4602 is 8000?

28. If bricks sell for $60.00 per thousand, how much do 100 bricks cost?

29. If 1000 pencils cost a dealer $65.00, each pencil costs __?__.

30. Monday morning the speedometer on Mary's father's automobile showed 6485, Tuesday morning 6831, and Tuesday evening 7324. How much farther did her father drive on Tuesday than on Monday?

Early units of measure

When early man first needed to measure distances, he used parts of his body. He measured by the width of his hand, by the length of his thumb joint, by the width of his first finger, and by the greatest stretch of his open fingers.

HAND-STRETCH OR SPAN

These measures were called the *palm* or *hand,* the *uncia,* the *digit,* and the *span.*

To measure longer distances ancestral man used the length from the tip of the elbow to the tip of the middle finger, and the stretch of the outspread arms. These measures became the *cubit* and the *fathom.* Some distances were measured with the *pace,* others with the *bowshot.*

Some of the body measures we still use. A horse is so many "hands" high. Water is "knee" deep. A little different idea is the statement that two boys live within "shouting distance" of each other.

When men began to cultivate crops and became owners of pieces of land, they invented other measures for distance and area. The *furlong* was the length of a plowed furrow. The *acre* measured the amount of land that could be plowed in one morning.

These measures caused all sorts of confusion. *Palms, digits,* and *cubits* were not the same on two different men. A *furlong* might be one length in one field and another length in another field.

To help make measures more nearly uniform, a king or a leader of a community might require that all measures refer to his hand or arm or foot. Thus, the *yard* was decreed by Henry I of England as the distance from the point of his nose to the end of his thumb when his arm was stretched to full length.

Confusing measures continued to be used for many years in early times. But today we have definite *standard measures.* For example, a standard *yard* is a length marked off on a very carefully made metal bar kept in Washington at the National Bureau of Standards. A yard is the same length wherever we go. A foot is a foot, a mile is a mile. The standard lengths are established by law and are accepted by the people.

1. Have 5 students measure one of the chalk troughs in your classroom to see how many spans or "hand-stretches" long it is. Compare the results. Why do the results vary?

2. Now have 5 students measure the trough with a yardstick. Do the results vary as much as in Ex. 1? Why not?

3. What are the advantages of using standard units of measure?

Measures of length

1. A foot is the same as __?__ inches. Hold your hands a foot apart. Have one of your classmates test your accuracy, using a foot rule.

MEASURES OF LENGTH
12 in. = 1 ft.
3 ft. = 1 yd.
$5\frac{1}{2}$ yd. = 1 rod (rd.)
320 rd. = 1 mile
5280 ft. = 1 mile

2. In $\frac{1}{3}$ of a foot there are __?__ inches.

3. Measure the length of your room to the nearest foot with a steel tape.

4. Make a rule for changing any number of inches to feet; feet to inches; yards to inches.

5. Illustrate each rule in Ex. 4.

6. Tom is 64 inches tall. Which of these measures represent his height?

5 ft. 4 in.	1 yd. 2 ft. 4 in.
$\frac{64}{12}$ ft.	$\frac{64}{36}$ yd.

7. If you divide 30 inches by 12 inches, the quotient tells you the number of __?__ in __?__ inches.

8. If you multiply 12 inches by 3, the product tells you the number of __?__ in __?__ feet.

9. To change 48 inches to yards, divide 48 inches by 36 inches. The quotient is $1\frac{12}{36}$ or $1\frac{1}{3}$. So 48 inches = __?__ yards.

10. To change 40 inches to feet, divide __?__ inches by __?__ inches. The quotient, $3\frac{1}{3}$, is the number of __?__ in 40 __?__.

11. To change $3\frac{1}{3}$ feet to inches, think: 1 foot is 12 inches, so $3\frac{1}{3}$ feet is $3\frac{1}{3}$ times 12 inches or __?__ inches.

12. To compare 24 inches with 1 yard, divide 24 inches by 36 inches. $\frac{24 \text{ in.}}{36 \text{ in.}} = \frac{2}{3}$. So 24 inches is __?__ of 1 yard.

13. To compare 8 inches with a foot, divide 8 inches by 12 inches. $\frac{8 \text{ in.}}{12 \text{ in.}} = \frac{2}{3}$. So 8 inches is __?__ of a foot.

14. To change $2\frac{1}{2}$ miles to feet, think: 1 mile = 5280 ft.; so $2\frac{1}{2}$ miles = __?__ × __?__, or __?__ feet.

15. An inch is __?__ of a foot; a foot is __?__ of a yard; a foot is __?__ of a mile; and a rod is __?__ of a mile.

16. A length of 52 inches is the same as __?__ ft. __?__ in.

17. 1 mile = 320 rods = __?__ yards = __?__ feet.

18. $\frac{1}{10}$ mile = __?__ feet; $1\frac{1}{10}$ miles = __?__ feet.

19. If you divide 400 rods by 320 rods, you find the number of __?__ in __?__ rods.

Measures of liquid, weight, and time

1. 1 gallon = 4 quarts = __?__ pints = __?__ cups.

MEASURES OF LIQUID		
2 tablespoons	=	1 fluid ounce
8 fluid ounces	=	1 cup
2 cups	=	1 pint (pt.)
2 pints	=	1 quart (qt.)
4 quarts	=	1 gallon (gal.)

2. $1\frac{1}{2}$ gallons = __?__ quarts = __?__ pints = __?__ cups.

3. 1 cup is __?__ of a pint, or __?__ of a quart, or __?__ of a gallon.

4. Harry wanted to change 25 quarts to gallons. He reasoned:

▶ In 4 quarts there is 1 gallon.

▶ So in 25 quarts there are as many gallons as there are 4's in 25.

$$25 \div 4 = 6\tfrac{1}{4}.$$

▶ There are __?__ gal. in 25 qt.

5. Use Harry's reasoning (Ex. 4) to find how many gallons there are in:

10 quarts 27 quarts 13 quarts

6. At 5 cents a cup, how much would a gallon of punch cost?

7. How would you change $\frac{1}{2}$ pint to fluid ounces?

8. How many pints are there in $1\frac{1}{2}$ gallons? $1\frac{1}{4}$ gal.? 1 gal. 1 pt.? $\frac{1}{8}$ gal.?

9. At 40 cents a fluid ounce, 8 tablespoonfuls of flavoring cost __?__.

10. Name something ordinarily weighed by the ounce; by the pound; by the ton.

MEASURES OF WEIGHT		
16 ounces (oz.)	=	1 pound (lb.)
2000 pounds	=	1 ton (T)

11. Show how you would change $2\frac{3}{4}$ pounds to ounces.

12. Frank wanted to change 1800 pounds to tons. He reasoned:

▶ In 2000 pounds there is 1 ton.

▶ So in 1800 pounds there are as many tons as there are 2000's in 1800.

$$1800 \div 2000 = \tfrac{1800}{2000} = \tfrac{18}{20} = \tfrac{9}{10}.$$

▶ There is __?__ of a ton in 1800 pounds.

13. Complete: 2400 pounds is $\frac{2400}{2000}$ tons, or __?__ tons.

14. To compare 18 months with a year, divide 18 months by 12 months. The quotient tells you that 18 months = __?__ years.

15. To compare 9 months with a year, divide __?__ by __?__. The quotient tells you that 9 months is what part of a year?

16. To find what part 8 months is of a year, divide __?__ by __?__. The quotient tells you that 8 months is what part of a year?

Practice with measures

In each of the exercises below copy the items in Column A and write opposite each item the correct answer from Column B. For example, for the first item in Ex. 1 your work should look like this:

A	B
1 pt.	$\frac{1}{2}$ qt.

1.

A	B
1 pt.	9 pt.
3 pt.	$1\frac{1}{2}$ qt.
5 pt.	$\frac{1}{2}$ qt.
$4\frac{1}{2}$ qt.	$2\frac{1}{2}$ gal.
6 qt.	$2\frac{1}{2}$ qt.
10 qt.	$1\frac{1}{2}$ gal.

2.

A	B
6 qt. 1 pt.	8 pt.
1 gal.	13 pt.
5 gal.	5 qt.
$3\frac{1}{2}$ gal.	17 qt.
4 gal. 1 qt.	20 qt.
20 half-pints	14 qt.

3.

8 in.	46 in.
81 in.	100 yd.
1 ft.	$\frac{1}{10}$ mi.
3 ft. 10 in.	$2\frac{1}{4}$ yd.
300 ft.	$\frac{2}{3}$ ft.
528 ft.	$\frac{1}{3}$ yd.

4.

$\frac{3}{4}$ yd.	440 yd.
1 yd. 9 in.	660 ft.
$5\frac{1}{2}$ yd.	45 in.
2 yd. 5 ft.	27 in.
$\frac{1}{8}$ mi.	3 yd. 2 ft.
$\frac{1}{4}$ mi.	$16\frac{1}{2}$ ft.

5.

90 sec.	20 sec.
$\frac{1}{3}$ min.	20 min.
$\frac{1}{2}$ min.	$\frac{3}{4}$ hr.
15 min.	$1\frac{1}{2}$ min.
45 min.	30 sec.
$\frac{1}{3}$ hr.	$\frac{1}{4}$ hr.

6.

$1\frac{1}{4}$ hr.	72 hr.
1 hr. 50 min.	1 da. 2 hr.
26 hr.	2 da.
48 hr.	$1\frac{1}{2}$ yr.
3 da.	75 min.
18 mo.	110 min.

7.

8 oz.	1 oz.
20 oz.	2 lb.
24 oz.	$\frac{1}{2}$ lb.
32 oz.	$1\frac{1}{2}$ lb.
$\frac{1}{16}$ lb.	4 oz.
$\frac{1}{4}$ lb.	$1\frac{1}{4}$ lb.

8.

2 lb. 3 oz.	3 lb.
500 lb.	$\frac{1}{10}$ ton
200 lb.	4 lb. 4 oz.
2 tons	$\frac{1}{4}$ ton
1 lb. 32 oz.	35 oz.
3 lb. 20 oz.	4000 lb.

Measures

In each column of Exs. 1–5 tell (1) which is larger, and (2) how much larger it is:

	a	*b*	*c*
1.	10 ft. or 3 yd.	34 oz. or 2 lb.	3 qt. or $\frac{1}{2}$ gal.
2.	2 hr. or 150 min.	2000 ft. or $\frac{1}{2}$ mi.	$\frac{1}{2}$ yd. or 20 in.
3.	2 gal. or 10 qt.	600 ft. or 302 yd.	$\frac{1}{2}$ lb. or 9 oz.
4.	10 pt. or 1 gal.	109 in. or 9 ft.	3 in. or $\frac{1}{3}$ ft.
5.	$\frac{1}{4}$ ft. or 4 in.	2 pt. or 5 cups	7 mo. or $\frac{3}{4}$ yr.

6. Joe wanted to add 7 weeks 5 days, 4 weeks 6 days, and 6 weeks 4 days. His addition is shown at the right.
Do you agree with his first result of 17 wk. 15 da.?
Do you agree with his final result of 19 wk. 1 da.?
How did he get the 1 da.? the 19 wk.?

7 wk.	5 da.
4 wk.	6 da.
6 wk.	4 da.
17 wk.	15 da.
19 wk.	1 da.

Find these sums:

	a	*b*	*c*	*d*
7.	3 gal. 3 qt.	6 lb. 7 oz.	2 hr. 45 min.	2 ft. 4 in.
	2 gal. 1 qt.	2 lb. 5 oz.	3 hr. 30 min.	8 ft. 9 in.
	5 gal. 2 qt.	1 lb. 4 oz.	4 hr. 20 min.	7 ft. 10 in.

8. Jane wanted to subtract 3 wk. 6 da. from 8 wk. 2 da. Her work is shown in the box. Before she subtracted, she changed 8 wk. 2 da. to _?_ wk. _?_ da. Why did she do that? Her answer was _?_ wk. _?_ da.

7	9
~~8~~ wk.	~~2~~ da.
3 wk.	6 da.
4 wk.	3 da.

Subtract and check:

	a	*b*	*c*	*d*
9.	5 ft. 8 in.	6 lb. 5 oz.	5 hr. 30 min.	5 yr. 2 mo.
	2 ft. 5 in.	3 lb. 6 oz.	4 hr. 45 min.	4 yr. 9 mo.
10.	5 ft. 5 in.	8 gal. 1 qt.	6 yd. 1 ft.	8 wk. 1 da.
	2 ft. 8 in.	4 gal. 3 qt.	3 yd. 2 ft.	5 wk. 5 da.

Review

Add:

1. 24
   20
   35
   42

2. 87
   34
   76
   52

3. 507
   524
   620
   93

4. 4,624
   9,762
   5,001
   6,723

5. $ .03
   .42
   .73
   1.40

6. Add horizontally and write the answer only:

   824 + 347 + 8354 + 97

7. Round off to the nearest thousand:

   a 2,227 *d* 842
   b 6,673 *e* 32,153
   c 1,720 *f* 25,497

8. Write in figures:

   Forty thousand six hundred two

9. Write in words: 6004

Subtract:

10. 63
    37

11. 275
    97

12. 713
    308

13. 7521
    845

14. 3000
    892

15. Write in Arabic numerals:

    MCMLV

16. From 64,509 subtract 32,784.

17. How much greater is 7004 than 1005?

18. Subtract horizontally, writing the answer only:

    8007 − 2735

Multiply:

19. 3189
    8

20. 5874
    7

21. 8653
    8

22. 265
    57

23. 86
    70

24. 432
    200

25. 752
    403

26. 8004
    7

27. $40.06
    8

28. Find the product of 204 and 402.

Divide:

29. 4)496

30. 8)832

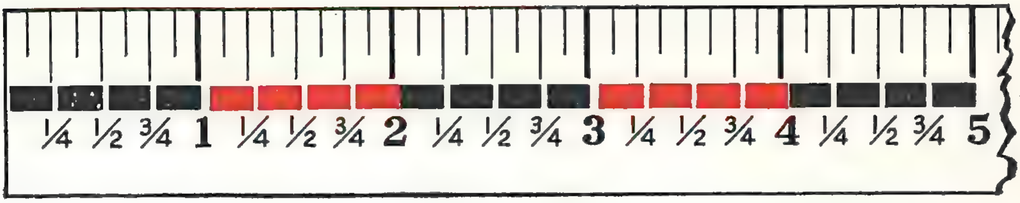
31. 83)2241

32. 21)6426

33. 63)25200

34. 123)5535

Studying eighths on a ruler



1. In this picture of a ruler each inch is divided into __?__ equal parts. Each of the 8 equal parts is one __?__ of an inch.

Find the answers to the following exercises by studying the ruler shown in the illustration.

2. Count by $\frac{1}{8}$'s, pointing to the correct mark on the ruler as you say: $\frac{1}{8}$, $\frac{2}{8}$ or $\frac{1}{4}$, $\frac{3}{8}$, $\frac{4}{8}$ or $\frac{1}{2}$, $\frac{5}{8}$, $\frac{6}{8}$ or $\frac{3}{4}$, $\frac{7}{8}$, $\frac{8}{8}$ or 1, $1\frac{1}{8}$, etc.

3. One half = __?__ eighths ($\frac{1}{2} = \frac{?}{8}$)

4. One fourth = __?__ eighths ($\frac{1}{4} = \frac{?}{8}$)

5. Three fourths = __?__ eighths ($\frac{3}{4} = \frac{?}{8}$)

	a	*b*
6.	$1 - \frac{1}{8} = \underline{\ ?\ }$	$1 - \frac{1}{4} = \underline{\ ?\ }$
7.	$2\frac{1}{2} + \frac{1}{4} = \underline{\ ?\ }$	$2\frac{1}{2} + \frac{1}{8} = \underline{\ ?\ }$
8.	$2\frac{1}{2} - \frac{1}{4} = \underline{\ ?\ }$	$2\frac{1}{2} - \frac{1}{8} = \underline{\ ?\ }$
9.	$2 - \frac{3}{8} = \underline{\ ?\ }$	$1\frac{3}{4} = 1\frac{?}{8}$

10. How many $\frac{1}{8}$'s are there in 2? ($2 \div \frac{1}{8} = \underline{\ ?\ }$)

11. How many $\frac{1}{8}$'s are there in $\frac{1}{2}$? ($\frac{1}{2} \div \frac{1}{8} = \underline{\ ?\ }$)

12. How many $\frac{1}{8}$'s are there in $2\frac{1}{2}$? ($2\frac{1}{2} \div \frac{1}{8} = \underline{\ ?\ }$)

13. How many $\frac{1}{8}$'s are there in 3? ($3 \div \frac{1}{8} = \underline{\ ?\ }$)

	a	*b*
14.	$1\frac{1}{2} + \underline{\ ?\ } = 1\frac{7}{8}$	$2\frac{1}{2} + \underline{\ ?\ } = 3\frac{1}{8}$
15.	$1\frac{3}{4} + \underline{\ ?\ } = 2\frac{3}{8}$	$1\frac{1}{8} + \frac{3}{8} + \frac{1}{2} = \underline{\ ?\ }$
16.	$1\frac{1}{4} + \frac{5}{8} + \frac{7}{8} = \underline{\ ?\ }$	$1\frac{5}{8} + \frac{1}{4} + \frac{3}{8} = \underline{\ ?\ }$

17. How many $\frac{3}{8}$'s are there in 3? ($3 \div \frac{3}{8} = \underline{\ ?\ }$)

18. How many $\frac{5}{8}$'s are there in $2\frac{1}{2}$? ($2\frac{1}{2} \div \frac{5}{8} = \underline{\ ?\ }$)

19. $\frac{3}{8} + \frac{3}{8} + \frac{3}{8} = \frac{?}{8} = 1\frac{?}{8}$

20. How does Ex. 19 show that $3 \times \frac{3}{8} = \frac{9}{8} = 1\frac{1}{8}$?

21. $\frac{5}{8} + \frac{5}{8} = \frac{?}{8} = 1\frac{?}{8} = 1\frac{?}{4}$

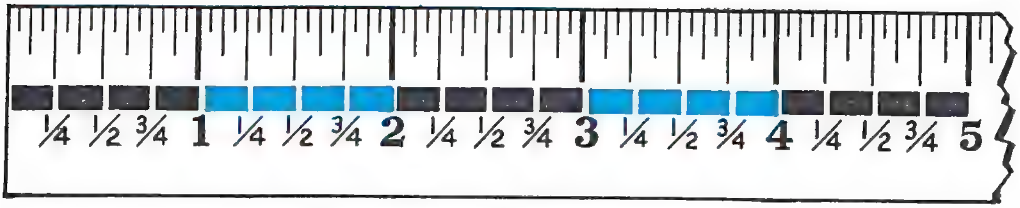
22. How does Ex. 21 show that $2 \times \frac{5}{8} = \frac{10}{8} = 1\frac{2}{8} = 1\frac{1}{4}$?

23. $\frac{2}{8} + \frac{2}{8} + \frac{2}{8} + \frac{2}{8} = \frac{?}{8} = \underline{\ ?\ }$

24. Does Ex. 23 show you how to find the answer to $4 \times \frac{2}{8}$? Explain.

25. $2\frac{1}{8} = \frac{?}{8}$ $\quad 3\frac{3}{8} = \frac{?}{8}$ $\quad 5\frac{5}{8} = \frac{?}{8}$

Studying sixteenths on a ruler



1. Each inch of the ruler shown above is divided into __?__ equal parts. Each of the 16 equal parts is __?__ of an inch.

2. Count by $\frac{1}{16}$'s, pointing to the correct mark on the ruler as you say: $\frac{1}{16}$, $\frac{2}{16}$ or $\frac{1}{8}$, $\frac{3}{16}$, $\frac{4}{16}$ or $\frac{1}{4}$, $\frac{5}{16}$, $\frac{6}{16}$ or $\frac{3}{8}$, $\frac{7}{16}$, $\frac{8}{16}$ or $\frac{1}{2}$, etc.

Use the ruler to help you do these examples:

3. One eighth = __?__ sixteenths ($\frac{1}{8} = \frac{?}{16}$)

4. $\frac{2}{8} = \frac{?}{4} = \frac{?}{16}$ $\quad$ $\frac{3}{8} = \frac{?}{16}$

$\frac{4}{8} = \frac{?}{2} = \frac{?}{16}$ $\quad$ $\frac{5}{8} = \frac{?}{16}$

$\frac{6}{8} = \frac{?}{4} = \frac{?}{16}$ $\quad$ $\frac{7}{8} = \frac{?}{16}$

5. The first mark to the right of the 1″ mark on the above ruler is read $1\frac{1}{16}''$. How do you read the first mark to the right of each of the following?

$1\frac{1}{8}''$	$1\frac{1}{2}''$	$1\frac{1}{4}''$	$1\frac{3}{4}''$
$2''$	$2\frac{3}{8}''$	$2\frac{5}{8}''$	$2\frac{7}{8}''$

6. The first mark to the left of the 1″ mark on the above ruler is read $\frac{15}{16}''$. How do you read the first mark to the left of each of the readings in Ex. 5?

7. The $2\frac{15}{16}''$ mark is $\frac{1}{16}''$ back from the 3″ mark. Tell how far ahead or back the first mark is from the second mark in each of the following:

$1\frac{1}{16}''$ from $1''$	$2\frac{5}{16}''$ from $2\frac{1}{8}''$
$2\frac{3}{16}''$ from $2\frac{1}{4}''$	$1\frac{11}{16}''$ from $1\frac{7}{8}''$
$1\frac{7}{16}''$ from $1\frac{1}{2}''$	$2\frac{7}{16}''$ from $2\frac{3}{8}''$
$2\frac{9}{16}''$ from $3''$	$1\frac{13}{16}''$ from $2''$

8. $1'' = \frac{?}{16}'' = \frac{?}{8}'' = \frac{?}{4}'' = \frac{?}{2}''$

9. $2\frac{1}{2}'' = \frac{?}{2}''$ $\quad$ $2\frac{1}{4}'' = \frac{?}{4}''$

$1\frac{3}{4}'' = \frac{?}{4}''$ $\quad$ $2\frac{3}{8}'' = \frac{?}{8}''$

10. $1\frac{7}{8}'' = \frac{?}{8}''$ $\quad$ $1\frac{3}{16}'' = \frac{?}{16}''$

$2\frac{13}{16}'' = \frac{?}{16}''$ $\quad$ $1\frac{5}{16}'' = \frac{?}{16}''$

11. A line $5\frac{5}{16}''$ long is __?__ of an inch longer than $5\frac{1}{4}''$.

12. Arrange in order of size with the smallest first: $2\frac{7}{8}''$ $\quad$ $2\frac{3}{4}''$ $\quad$ $2\frac{13}{16}''$

13. Arrange in order of size with the largest first: $1\frac{9}{16}$ $\quad$ $1\frac{3}{4}$ $\quad$ $1\frac{11}{16}$ $\quad$ $1\frac{5}{8}$

14. $1\frac{1}{2} + \frac{3}{16} =$ __?__ $\quad$ $2\frac{1}{4} - \frac{3}{16} =$ __?__

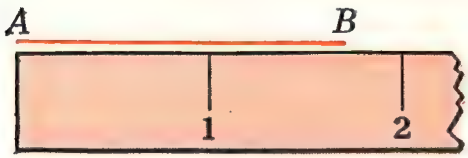
15. $1\frac{3}{4} + \frac{5}{16} =$ __?__ $\quad$ $2\frac{3}{4} - \frac{3}{16} =$ __?__

16. $2\frac{3}{8} + \frac{7}{16} =$ __?__ $\quad$ $2\frac{3}{8} - \frac{7}{16} =$ __?__

17. $4 \times \frac{3}{16} =$ __?__ $\quad$ $5 \times \frac{5}{16} =$ __?__

Precision in measurement

1. Tom used a ruler graduated to whole inches to measure line AB.



He reported that the length of AB, *to the nearest inch,* is _?_ inches.

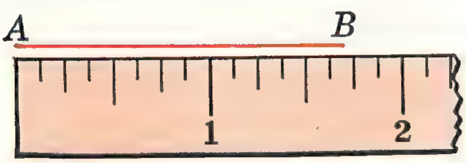
2. Mary also measured AB, but with a ruler graduated to half inches.

She reported that the length of AB, *to the nearest half inch,* is _?_ inches.

3. Joe measured AB with a ruler graduated to fourths of an inch.

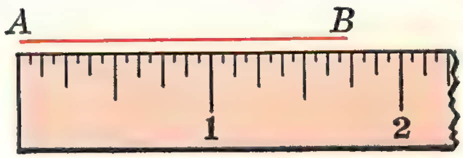
He found that the length of AB, *to the nearest fourth of an inch,* is _?_ inches.

4. Jane measured AB with a ruler graduated to eighths of an inch.



She said that the length of AB, *to the nearest eighth of an inch,* is _?_ inches.

5. Bill measured AB with a ruler graduated to sixteenths of an inch.



He decided that the length of AB, *to the nearest sixteenth of an inch,* is _?_ inches.

6. With a ruler graduated to 32nds of an inch, you can measure to the nearest _?_ of an inch.

7. In Ex. 1, did Tom mean that the length of AB is exactly 2 inches?

8. In Exs. 2–5, was the length of AB measured exactly?

All measurement is approximate, never exact.

9. In Ex. 1, the unit of measure was _?_ inch. In Ex. 2 it was _?_ inch. In Ex. 3 it was _?_ inch. In Ex. 4 it was _?_ inch. In Ex. 5 it was _?_ inch.

The smaller the unit of measure, the greater the *precision* of the measurement.

10. Using a ruler graduated to 16ths of an inch, Leo reported the length of a line to be $4\frac{3}{16}$ inches.

Could the length of the line have been a little less than $4\frac{3}{16}$? a little more than $4\frac{3}{16}$?

Using a ruler

a ———— b ————

c ———— d ————

e ———— f ————

g ———— h ————

i ———— j ————

k ———— l ————

1. Measure each of the above lines to the nearest sixteenth of an inch. Reduce answers to the simplest form.

2. Measure the length of a page in this book to the nearest $\frac{1}{8}$ inch; to the nearest $\frac{1}{16}$ inch.

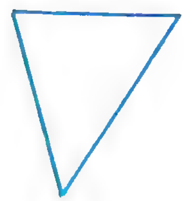
3. Draw lines of these lengths:

$1\frac{1}{4}''$	$2\frac{1}{8}''$	$3\frac{7}{8}''$	$3\frac{15}{16}''$
$5\frac{3}{16}''$	$5\frac{11}{16}''$	$2\frac{3}{4}''$	$2\frac{3}{8}''$
$3\frac{5}{8}''$	$3\frac{7}{16}''$	$5\frac{9}{16}''$	$5\frac{13}{16}''$

4. Draw a line $2\frac{5}{16}''$ long. If $\frac{1}{16}$ inch represents a mile, what distance will your line represent?

5. Draw a line about 8 inches long.
- At the extreme left end mark point A.
- From point A measure along the line $2\frac{1}{2}''$ and mark point B.
- From point B measure along the line $3\frac{1}{4}''$ and mark point C.
- From point C measure $1\frac{3}{16}''$ and mark point D.
- Measure the line AD. $2\frac{1}{2}'' + 3\frac{1}{4}'' + 1\frac{3}{16}'' =$ _?_ $''$.

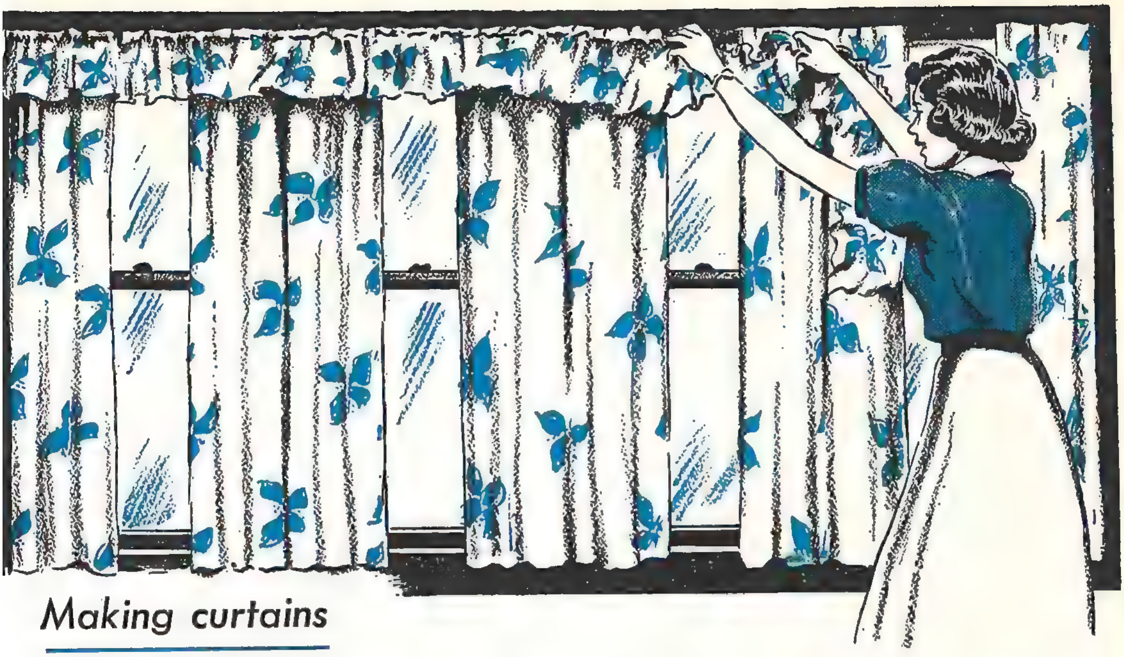
6. Measure to the nearest $\frac{1}{8}$ inch each of the three sides of the triangle shown at the right. What is the sum of the sides?



7. Draw another line about 9 inches long and mark point A at the left end. This time measure $2\frac{3}{4}''$ from A to B, $2\frac{3}{4}''$ from B to C, and $2\frac{3}{4}''$ from C to D. How long is AD? $3 \times 2\frac{3}{4}'' =$ _?_ $''$.

8. Mark off $\frac{3}{4}''$ six times in succession on a straight line. The total length you have marked off is _?_ $''$. Your work shows that $6 \times \frac{3}{4} =$ _?_. It also shows that there are _?_ $\frac{3}{4}$'s in $4\frac{1}{2}$. $4\frac{1}{2} \div \frac{3}{4} =$ _?_.

9. Use your ruler to help you find the answer to the following:
- How many $1\frac{1}{2}$'s are there in 6? $6 \div 1\frac{1}{2} =$ _?_
- How many $1\frac{3}{4}$'s are there in $10\frac{1}{2}$? $10\frac{1}{2} \div 1\frac{3}{4} =$ _?_
- How many $1\frac{5}{16}$'s are there in $5\frac{1}{4}$? $5\frac{1}{4} \div 1\frac{5}{16} =$ _?_



Making curtains

Ann made new curtains for the kitchen.

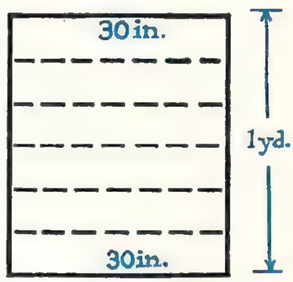
1. The four small windows in Ann's kitchen are 40 inches high. Each window needed 2 curtains. Ann added 5 inches to each curtain length for hems. How many inches of material did she need?

2. How many yards of material were needed?

3. Flowered material for the curtains cost 59¢ a yard. How much did Ann pay for the curtain material?

4. Ann's mother had told her that she should use a strip of material about $2\frac{1}{2}$ times the total width of the windows to make a ruffle across the top of the windows. Each of the 4 windows is 18 inches wide; so the strip for the ruffle needed to be $2\frac{1}{2} \times 4 \times 18$ in., or _?_ in. long.

5. To make the ruffle Ann bought 1 yard of material 30 inches wide. She cut the material as shown in the diagram.



She made _?_ equal strips. Each strip was _?_ inches deep and _?_ inches long.

6. To make one long strip out of the six strips, would there be 5 or 6 seams?

7. Ann made $\frac{1}{2}$-inch seams when she sewed the strips together into the long strip for the ruffle. She said the finished strip for the ruffle was 175 inches long. Show that she was right.

8. The material for the ruffle cost 65¢. What was the total cost of the curtains and ruffle? (See Ex. 3)

Using measures

1. Jim wants to put a record cabinet 33 inches long and 26 inches high between two bookcases under a window in his room. He measures the space and finds that he has 3 feet between the bookcases and 2 feet 6 inches up to the window sill. Will the cabinet fit the space?

2. Bill has strawberry plants to be set out 5 in a row. The plants are to be set 18 inches apart, with 18 inches at each end of the row. How many feet will he need for each row?

3. Mr. Hall (shown below) is buying tickets for the family to return home on the plane that leaves at 10:15. How many minutes will they have before the plane leaves?

4. Their flight (Ex. 3) should take 2 hours 5 minutes. At what time do they expect to reach their home city?

5. The cooking classes volunteered to make 400 cookies for a hospital party. They decided to make 34 dozen. This would make __?__ cookies.

6. The recipe for cookies uses $\frac{1}{2}$ cup milk for a mixture that makes 3 dozen. How many whole quarts of milk should be ordered to make the 34 dozen cookies?

7. Tom and his father want to make a table top 5 feet 6 inches long for games in the play room. They plan to nail 3 boards side by side to make the top. They have one board 12 feet long, one 5 feet long, and one 6 feet long. Which boards can they use? Draw a diagram to show how they would cut the boards.

8. Jane's Service Club has agreed to cut and decorate 60 paper mats each 20 inches long. They can buy paper in 21-foot or 75-foot rolls.

How many mats can be cut from the 21-foot roll? Will there be any waste?

How many can be cut from a 75-foot roll? Will there be any waste?

Will a 75-foot roll and a 21-foot roll make 60 mats?

What do you know about fractions?

Do you remember these three uses of *fractions*?

▶ Mary cut a sheet of paper into 4 equal parts. She used 3 of the 4 equal parts.

In the fraction $\frac{3}{4}$, the 3 tells the *number of parts* she used; the 4 tells the *size of each of the parts* (fourths).

▶ To tell *what part* of a pie each boy will get if 5 boys share 2 pies equally, George used a fraction.

- If the 5 boys first share one pie equally, each boy will get $\frac{1}{5}$ of a pie.
- If they share the second pie equally, each boy will get $\frac{1}{5}$ of it.
- All together each boy will get $\frac{1}{5}$ of 2 pies or $\frac{2}{5}$ of a pie. $2 \div 5 = \frac{2}{5}$

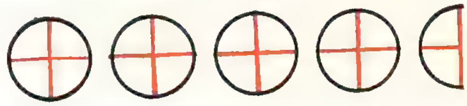
▶ Joe used a fraction to show *comparison* of two numbers.

To compare 18 inches with a yard (36 inches), he wrote the fraction $\frac{18 \text{ in.}}{36 \text{ in.}} = \frac{1}{2}$.

To compare 3 ounces with a pound, Joe wrote the fraction $\frac{3 \text{ oz.}}{16 \text{ oz.}} = \frac{3}{16}$.

1. Write fractions to show (*a*) what part of a whole pie each of 4 boys would get when they share 3 pies equally; (*b*) 3 of the 4 equal parts into which a pie may be cut; and (*c*) the comparison of 3 pies with 4 pies.

2. Count the $\frac{1}{4}$'s in the picture below this way: $\frac{1}{4}$, $\frac{2}{4}$, $\frac{3}{4}$, $\frac{4}{4}$, $\frac{5}{4}$, etc.



3. Now use the picture to count by $\frac{1}{4}$'s this way: $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, 1, $1\frac{1}{4}$, etc.

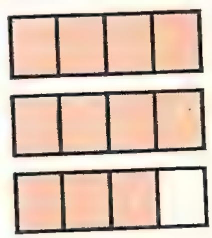
4. Use the picture in Ex. 2 to:

- find the sum of $1\frac{1}{2}$ and $2\frac{1}{4}$.
- find the difference between 4 and $2\frac{3}{4}$.
- find $3 \times \frac{3}{4}$.
- find how many $\frac{3}{4}$'s there are in $3\frac{3}{4}$.

5. Is the sum of $2\frac{1}{2}$ and $3\frac{1}{4}$ between 5 and 6, or is it between 6 and 7?

6. How does this figure show that $\frac{1}{2}$ has the same value as $\frac{3}{6}$?

7. Explain how the drawing at the right shows that $2\frac{3}{4} = \frac{11}{4}$.



8. Estimate: Is $2\frac{1}{2} \times 3\frac{1}{4}$ nearer to 7, 15, or 25?

9. Estimate: Is $10\frac{1}{2} \div 5\frac{1}{4}$ nearer to 5, 3, or 2?

10. How much butter is $\frac{1}{2}$ of one half a pound of butter?

$\frac{1}{2} \times \frac{1}{2} = \underline{\ ?\ }$

Thinking about fractions

1. Numbers like $\frac{2}{3}$, $\frac{3}{2}$, and $\frac{6}{6}$ are fractions. In the fraction $\frac{2}{3}$, the 2 is the ***numerator*** and the 3 is the ***denominator.*** Which is the numerator and which is the denominator of the fraction $\frac{3}{2}$?

2. A ***proper fraction*** is one that is less than a whole. In a proper fraction the numerator is always less than the denominator.

Which one of the three fractions in Ex. 1 is a proper fraction? Give five other illustrations of proper fractions.

3. A fraction in which the numerator is either equal to the denominator or greater than the denominator is called an ***improper fraction.*** It is equal to a whole or more than a whole. $\frac{6}{6}$ and $\frac{3}{2}$ are improper fractions. Give five other illustrations of improper fractions.

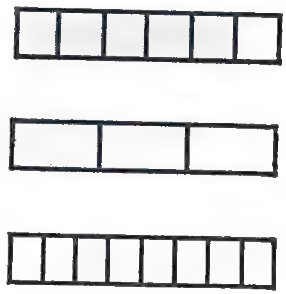
4. Numbers like $2\frac{1}{4}$, $3\frac{1}{2}$, and $4\frac{5}{6}$ are ***mixed numbers.*** Which of the following are mixed numbers?

$\frac{3}{4}$ $\quad 1\frac{1}{2}$ $\quad \frac{4}{5}$ $\quad \frac{2}{3}$ $\quad 5\frac{1}{6}$

5. You know that 2 fourths is the same as 1 half ($\frac{2}{4} = \frac{1}{2}$), and that 6 eighths is the same as 3 fourths ($\frac{6}{8} = \frac{3}{4}$). Check with your ruler.

Fractions that have different forms but the same value are ***equivalent fractions.*** Give five fractions that are equivalent to $\frac{1}{2}$ and two fractions that are equivalent to $\frac{2}{3}$.

6. Fractions whose denominators are alike are called ***like fractions.*** $\frac{2}{7}$ and $\frac{3}{7}$ are like fractions. Do you know how to add like fractions?



7. Which figure above has $\frac{1}{8}$ of it colored? $\frac{2}{3}$? $\frac{5}{6}$?

Use figures like those above to help you find:

	a	*b*	*c*
8.	$\frac{3}{6} + \frac{2}{6}$	$1 - \frac{1}{6}$	$1 - \frac{1}{3}$
9.	$1 - \frac{5}{6}$	$\frac{5}{6} + \frac{1}{6}$	$\frac{4}{6} = \frac{?}{3}$
10.	$\frac{1}{2}$ of $\frac{1}{3}$	$\frac{1}{2}$ of $\frac{2}{3}$	$\frac{1}{3}$ of $\frac{1}{2}$
11.	$\frac{2}{3} + \frac{1}{3}$	$\frac{6}{6} - \frac{5}{6}$	$\frac{2}{3} \div \frac{1}{6}$

Use a ruler to help you find:

12.	$\frac{1}{4} + \frac{1}{4}$	$\frac{1}{2} + \frac{1}{4}$	$1\frac{3}{8} + \frac{1}{4}$
13.	$2\frac{1}{4} + \frac{1}{4}$	$1\frac{1}{2} + \frac{1}{4}$	$1\frac{1}{4} + \frac{1}{2}$
14.	$\frac{5}{4} = 1\frac{?}{4}$	$1\frac{7}{8} = \frac{?}{8}$	$\frac{6}{2}$ is __?__
15.	$2 - \frac{3}{8}$	$2\frac{1}{2} + \frac{3}{8}$	$\frac{23}{8} = 2\frac{?}{8}$
16.	$\frac{3}{4} - \frac{1}{4}$	$\frac{3}{4} - \frac{1}{2}$	$1\frac{1}{2} - \frac{3}{8}$
17.	$4\frac{1}{4} + \frac{7}{8}$	$1\frac{1}{8} - \frac{3}{4}$	$\frac{7}{8} + 5\frac{3}{4}$

Equivalent fractions

1. Janet needs $\frac{1}{4}$ yd. of lace for each of two pockets on a dress. At the store should she ask for $\frac{2}{4}$ of a yard or $\frac{1}{2}$ of a yard? Explain.

When a fraction has the smallest numbers it can have in the numerator and the denominator, it has been *reduced to lowest terms.*

2. Draw a diagram to show that $\frac{4}{6} = \frac{2}{3}$.

3. Make a rule for reducing a fraction to lowest terms. Illustrate.

4. Which of these fractions is in lowest terms? $\frac{6}{8}$ $\frac{12}{16}$ $\frac{7}{8}$ $\frac{3}{5}$ $\frac{6}{16}$

To reduce a fraction to lowest terms, divide the numerator and the denominator of the fraction by the largest number that will divide both evenly.

Reduce to lowest terms:

5. $\frac{3}{9}$ $\frac{3}{12}$ $\frac{3}{15}$ $\frac{6}{12}$ $\frac{9}{24}$

6. $\frac{2}{12}$ $\frac{10}{16}$ $\frac{9}{12}$ $\frac{8}{12}$ $\frac{8}{10}$

7. Reducing a fraction to lowest terms is one way of changing a fraction to an equivalent fraction. The new denominator is *smaller* than the given denominator. Illustrate.

8. To add or subtract fractions, you may need to change a fraction to an equivalent fraction in which the new denominator is *larger* than the given denominator. Illustrate.

9. Make a rule for changing a fraction to an equivalent fraction with a larger denominator. Illustrate.

To change a fraction to an equivalent fraction with a larger denominator, multiply the numerator and the denominator by the same number.

10. $\frac{3}{4} = \frac{3 \times ?}{4 \times ?} = \frac{?}{8}$ $\frac{2}{3} = \frac{2 \times ?}{3 \times ?} = \frac{?}{6}$

11. $\frac{1}{2} = \frac{?}{4}$ $\frac{2}{3} = \frac{?}{9}$ $\frac{3}{4} = \frac{?}{12}$

12. $\frac{3}{4} = \frac{?}{16}$ $\frac{3}{4} = \frac{?}{8}$ $\frac{4}{9} = \frac{?}{27}$

13. Bob said, "The value of a fraction does not change if you multiply (or divide) the numerator and the denominator by the same number. I wonder if the value of a fraction changes if you add (or subtract) the same number in the numerator and the denominator."

Can you answer Bob's question?

- Start with $\frac{1}{2}$. Add 1 to both the numerator and the denominator. Did you change the value of the $\frac{1}{2}$?

- Now start with $\frac{3}{4}$. Subtract 2 from both the numerator and the denominator. Did you change the value of the $\frac{3}{4}$?

- Now make statements about what you *can* and *cannot* do to the numerator and the denominator of a fraction without changing its value.

Changing improper fractions and mixed numbers

1. Draw a diagram to show that $\frac{7}{4} = 1\frac{3}{4}$.

2. Can you make a rule for changing an improper fraction to a mixed number?

$$\boxed{\frac{7}{4} = 7 \div 4 = 1\frac{3}{4}}$$

To change an improper fraction to a whole number or mixed number, divide the numerator by the denominator.

Change to whole numbers or mixed numbers:

	a	b	c	d
3.	$\frac{11}{4}$	$\frac{17}{5}$	$\frac{3}{2}$	$\frac{8}{8}$
4.	$\frac{15}{3}$	$\frac{15}{2}$	$\frac{13}{8}$	$\frac{9}{4}$

5. Tom wanted to find the sum of $5\frac{7}{8}$ and $4\frac{7}{8}$. When he added the two mixed numbers, he found the sum to be $9\frac{14}{8}$. What change should he make in the sum $9\frac{14}{8}$?

Tell the missing numerators:

6. $4\frac{3}{2} = 5\frac{?}{2}$ $\qquad 6\frac{5}{4} = 7\frac{?}{4}$

7. $9\frac{5}{3} = 10\frac{?}{3}$ $\qquad 16\frac{8}{5} = 17\frac{?}{5}$

8. Draw a diagram to show that $5\frac{2}{3} = \frac{17}{3}$.

9. Can you make a rule for changing $5\frac{2}{3}$ to $\frac{17}{3}$ without the help of a diagram?

10. To change $5\frac{2}{3}$ to $\frac{17}{3}$ without a diagram, think:

▶ In 1 whole there are 3 thirds, so in 5 wholes there are 5×3 thirds, or 15 thirds.

▶ Then the 15 thirds + 2 thirds make 17 thirds.

▶ So $5\frac{2}{3} = \frac{?}{3}$.

To change a mixed number to an improper fraction, multiply the denominator of the fraction by the whole number and then add the numerator to this product.

The number you get is the numerator of the improper fraction. The denominator of the improper fraction is the same as the denominator of the original fraction.

Change to improper fractions:

	a	b	c	d
11.	$3\frac{1}{2}$	$2\frac{1}{3}$	$7\frac{4}{5}$	$9\frac{3}{8}$
12.	$5\frac{3}{4}$	$4\frac{1}{4}$	$1\frac{7}{8}$	$6\frac{3}{5}$

13. Tom says there are many everyday uses of changing a mixed number to an improper fraction. He gave the two illustrations below. Can you give others?

- If you change $2\frac{1}{4}$ dollars into quarters you get __?__ quarters. This shows that $2\frac{1}{4} = \frac{?}{4}$.
- My sister Ann had 1 whole apple pie and $\frac{1}{6}$ of another apple pie. She cut the whole pie into 6 equal servings. Then she had 7 servings, or 7 sixths. This shows that $1\frac{1}{6} = \frac{?}{6}$.

Finding common denominators

1. 2 eighths + 3 eighths = __?__ eighths. $\frac{2}{8} + \frac{3}{8} = \frac{2+3}{8} = \frac{?}{?}$

2. 9 sixteenths + 5 sixteenths = __?__ sixteenths.

$$\frac{9}{16} + \frac{5}{16} = \frac{9+5}{16} = \frac{?}{?}$$

3. Explain the example in the box at the right.

$$\begin{array}{r} \frac{6}{8} \\ + \frac{7}{8} \\ \hline \frac{13}{8} = 1\frac{5}{8} \end{array}$$

4. Like fractions, those whose denominators are alike, can be added or subtracted by adding or subtracting the __?__.

Add or subtract the following fractions. Change answers to simplest form.

5.	$\frac{1}{4} + \frac{2}{4}$	$\frac{5}{12} + \frac{8}{12}$	$\frac{7}{8} - \frac{1}{8}$	$\frac{6}{6} - \frac{3}{6}$
6.	$\frac{9}{16} + \frac{7}{16}$	$\frac{1}{2} + \frac{1}{2}$	$\frac{9}{16} - \frac{1}{16}$	$\frac{4}{5} - \frac{3}{5}$

▶ When the denominators of several fractions are not alike, the fractions must be changed so that the denominators are alike before the fractions can be either added or subtracted.

▶ The new denominator is called the *common denominator.*

▶ You should use the *smallest common denominator* because it is easiest to work with.

7. Explain the example in the box.

$$\begin{array}{r} \frac{1}{2} = \frac{3}{6} \\ + \frac{2}{3} = \frac{4}{6} \\ \hline \frac{7}{6} = 1\frac{1}{6} \end{array}$$

Here is a good way to find the common denominator for two or more fractions:

▶ Look to see if the largest denominator is the common denominator.

▶ If not, try 2 times the largest denominator.

▶ If that won't do, try 3 times the largest denominator, and so on.

First tell what common denominators you would use in adding or subtracting these fractions. Then do the examples. Change answers to simplest form.

	a	*b*	*c*	*d*
8.	$\frac{1}{4} + \frac{1}{2}$	$\frac{3}{8} + \frac{1}{4}$	$\frac{1}{3} + \frac{1}{2}$	$\frac{2}{7} + \frac{4}{7}$
9.	$\frac{5}{8} - \frac{1}{2}$	$\frac{3}{8} - \frac{1}{4}$	$\frac{1}{6} + \frac{1}{4}$	$\frac{1}{4} + \frac{5}{16}$
10.	$\frac{7}{8} - \frac{1}{2}$	$\frac{5}{8} - \frac{1}{4}$	$\frac{2}{3} - \frac{1}{6}$	$\frac{5}{16} - \frac{1}{4}$
11.	$\frac{1}{2}, \frac{1}{3}, + \frac{1}{4}$	$\frac{1}{2}, \frac{7}{12}, + \frac{3}{4}$	$\frac{5}{8}, \frac{3}{16}, + \frac{1}{2}$	$\frac{7}{10}, \frac{1}{2}, + \frac{4}{5}$
12.	$\frac{3}{4}, \frac{2}{3}, + \frac{5}{6}$	$\frac{2}{5}, \frac{3}{4}, + \frac{1}{2}$	$\frac{7}{8}, \frac{5}{16}, + \frac{3}{4}$	$\frac{1}{6}, \frac{3}{5}, + \frac{2}{3}$

Adding mixed numbers

1. The diagram below represents $2\frac{1}{2}$ yd. and $1\frac{1}{4}$ yd. of wire. How many whole yards are there in all? How much wire is there in all?

2. Study the example in the box. The sum of the 3 whole numbers is __?__; the sum of the 3 fractions is __?__; the mixed number $12\frac{23}{12}$ has been changed to __?__.

$$\begin{aligned} 3\tfrac{1}{2} &= 3\tfrac{6}{12} \\ 4\tfrac{2}{3} &= 4\tfrac{8}{12} \\ 5\tfrac{3}{4} &= 5\tfrac{9}{12} \\ \hline & 12\tfrac{23}{12} = 13\tfrac{11}{12} \end{aligned}$$

Do the following additions. Change answers to simplest form.

	a	b	c	d
3.	$2\frac{1}{3}$ $4\frac{1}{2}$	$5\frac{1}{2}$ $6\frac{3}{4}$	$5\frac{2}{3}$ $4\frac{3}{4}$	$8\frac{3}{5}$ $2\frac{1}{4}$
4.	$8\frac{3}{5}$ $2\frac{3}{4}$	$7\frac{2}{3}$ $5\frac{3}{4}$	$8\frac{8}{9}$ $2\frac{1}{3}$	$3\frac{5}{6}$ $2\frac{2}{3}$
5.	$9\frac{1}{4}$ $6\frac{1}{3}$	$7\frac{1}{3}$ $4\frac{1}{4}$	$2\frac{1}{3}$ $8\frac{3}{4}$	$5\frac{1}{6}$ $7\frac{3}{4}$
6.	7 $8\frac{5}{16}$ $9\frac{7}{8}$	$3\frac{3}{4}$ $8\frac{4}{5}$ $2\frac{7}{10}$	$2\frac{5}{12}$ $8\frac{5}{8}$ $3\frac{1}{4}$	$2\frac{1}{4}$ $3\frac{1}{3}$ $2\frac{5}{6}$
7.	$5\frac{5}{8}$ $6\frac{1}{2}$ $3\frac{1}{4}$	$7\frac{2}{9}$ $5\frac{1}{3}$ $2\frac{1}{2}$	$9\frac{2}{5}$ $7\frac{1}{8}$ $5\frac{3}{4}$	$6\frac{3}{8}$ $4\frac{1}{10}$ $8\frac{4}{5}$

8. Show by addition that:
$3 \times 4\frac{2}{5} = 13\frac{1}{5}$ $\qquad$ $15 \div 2\frac{1}{2} = 6$

9. Ellen bought $5\frac{1}{4}$ yards of white ribbon, $5\frac{1}{2}$ yards of yellow ribbon, and $5\frac{3}{4}$ yards of green ribbon. She used it all to gift-wrap some presents. How many yards did she use?

10. Tom's mother is going to make him a pair of blue denim slacks. The pattern calls for $2\frac{1}{8}$ yd. of material. She has two pieces of denim. One is $1\frac{1}{8}$ yd. long. The other $1\frac{1}{4}$ yd. long. Has she enough material?

11. Peter is going to visit at his grandfather's ranch in Texas. To make the trip he has a $2\frac{1}{2}$-hour plane ride, a $1\frac{1}{4}$-hour wait in Houston, and then a $1\frac{3}{4}$-hour bus ride out to the ranch. How long will the whole trip take?

12. Would you estimate the sum of $6\frac{7}{8}$ and $5\frac{3}{4}$ to be closer to 11, or to 12, or to 13? Do the addition and check your estimate.

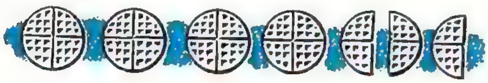
13. Margaret's mother drives her to school each morning. Margaret estimated these distances on a map: From her home to the place where they stopped to pick up Bill and Ann is $2\frac{3}{4}$ miles. It is $1\frac{1}{8}$ miles farther to Tom's house and then $3\frac{1}{4}$ miles to school.

How far does Margaret's mother drive to school each morning?

Subtracting fractions and mixed numbers

1. Could you take $\frac{3}{4}$ of a waffle from $\frac{1}{2}$ of a waffle?

Then how is it possible to take $2\frac{3}{4}$ waffles from $5\frac{1}{2}$ waffles?



• In the diagram you can see that $5\frac{1}{2}$ is the same as $4\frac{3}{2}$.

• $\frac{3}{2} = \frac{?}{4}$; so $4\frac{3}{2} = 4\frac{6}{4}$.

• The $2\frac{3}{4}$ waffles are taken away from $4\frac{6}{4}$ waffles. How many waffles are left?

• $4\frac{6}{4} - 2\frac{3}{4} =$ _?_.

2. Could you cut $\frac{3}{4}$ yard of string from a piece $\frac{1}{2}$ yd. long?

Then how is it possible to cut $2\frac{3}{4}$ yd. of string from a piece $5\frac{1}{2}$ yd. long? How long a piece would you have left?

3. Explain what you do to subtract mixed numbers in which the fractional part of the subtrahend is larger than the fractional part of the minuend. Illustrate.

4. Study John's and Peter's work in subtracting $4\frac{3}{4}$ from $7\frac{2}{3}$. Explain what each one did.

What is the difference in their work? Whose way do you prefer? Why?

JOHN

$$\begin{array}{rcccl} & 7\frac{2}{3} & = & 7\frac{8}{12} & = & 6\frac{20}{12} \\ - & 4\frac{3}{4} & = & 4\frac{9}{12} & = & 4\frac{9}{12} \\ \hline & & & & & 2\frac{11}{12} \end{array}$$

PETER

$$\begin{array}{rccl} & & & \scriptstyle 6\ \ 20 \\ & 7\frac{2}{3} & = & 7\frac{8}{12} \\ - & 4\frac{3}{4} & = & 4\frac{9}{12} \\ \hline & & & 2\frac{11}{12} \end{array}$$

Do the following subtractions. Change answers to simplest form.

5.

$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{3}{4}$
$\frac{3}{8}$	$\frac{1}{6}$	$\frac{1}{9}$	$\frac{2}{9}$	$\frac{1}{2}$

6.

$8\frac{3}{4}$	$10\frac{3}{8}$	$11\frac{5}{12}$	$12\frac{2}{3}$	$12\frac{3}{8}$
$2\frac{1}{5}$	$2\frac{3}{4}$	$7\frac{3}{4}$	$4\frac{3}{8}$	$4\frac{2}{3}$

7.

$8\frac{2}{3}$	$8\frac{1}{2}$	$18\frac{5}{9}$	5	7
$5\frac{1}{2}$	$5\frac{2}{3}$	$2\frac{3}{4}$	$2\frac{8}{9}$	$2\frac{1}{5}$

8. Last week Carol's mother bought an 8-pound ham. She weighed what was left of it today and it weighed $3\frac{3}{8}$ lb. She found that she had used _?_ lb.

9. Martha bought a piece of meat that weighed $5\frac{1}{2}$ lb. When the bone was removed, the meat weighed $4\frac{3}{4}$ lb. How much weight was lost when the bone was taken out?

10. Allen bought a $10\frac{1}{2}$-foot roll of rubber insulating tape. He used $2\frac{3}{4}$ ft. of the tape to wrap a damaged cord on his mother's electric washer. How many feet of tape were left in the roll?

11. The average length of a head of wheat has been increased from $4\frac{1}{2}$ inches to $9\frac{3}{4}$ inches. How much is the increase?

12. Would you estimate the difference between $15\frac{4}{5}$ and $20\frac{1}{10}$ to be closer to 4, or to 5, or to 6? Check your estimate by subtracting.

Practice with fractions and mixed numbers

Reduce these fractions:

	a	b	c
1.	$\frac{3}{6}$	$\frac{16}{24}$	$\frac{24}{36}$
2.	$\frac{12}{30}$	$\frac{20}{25}$	$\frac{8}{20}$
3.	$\frac{9}{12}$	$\frac{5}{15}$	$\frac{8}{8}$
4.	$\frac{27}{36}$	$\frac{8}{14}$	$\frac{16}{20}$

Change to whole or mixed numbers:

	a	b	c
5.	$\frac{6}{5}$	$\frac{17}{4}$	$\frac{13}{8}$
6.	$\frac{13}{6}$	$\frac{9}{4}$	$\frac{21}{5}$
7.	$\frac{5}{5}$	$\frac{15}{8}$	$\frac{12}{4}$
8.	$\frac{8}{3}$	$\frac{25}{7}$	$\frac{42}{5}$

Change to equivalent fractions with the indicated denominators:

	a	b
9.	$\frac{1}{2} = \frac{?}{6}$	$\frac{2}{3} = \frac{?}{12}$
10.	$\frac{3}{8} = \frac{?}{16}$	$\frac{1}{4} = \frac{?}{16}$
11.	$\frac{4}{5} = \frac{?}{20}$	$\frac{5}{8} = \frac{?}{24}$
12.	$\frac{2}{3} = \frac{?}{18}$	$\frac{1}{2} = \frac{?}{10}$

Change to improper fractions:

	a	b	c
13.	$2\frac{2}{3}$	$1\frac{1}{4}$	$6\frac{2}{3}$
14.	$3\frac{1}{2}$	$8\frac{1}{3}$	$12\frac{3}{5}$
15.	$2\frac{1}{5}$	$3\frac{1}{8}$	$1\frac{2}{3}$
16.	$3\frac{1}{5}$	$1\frac{1}{3}$	$5\frac{1}{3}$

Add:

	a	b	c
17.	$5\frac{3}{4}$ $\underline{7\frac{2}{3}}$	$8\frac{2}{3}$ $\underline{4\frac{1}{2}}$	$3\frac{1}{4}$ $\underline{9\frac{1}{2}}$
18.	$6\frac{1}{4}$ $\underline{5\frac{3}{10}}$	$4\frac{5}{6}$ $\underline{7\frac{4}{5}}$	$3\frac{5}{8}$ $\underline{8\frac{5}{12}}$
19.	$9\frac{3}{4}$ $\underline{4\frac{1}{4}}$	$4\frac{1}{5}$ $\underline{5\frac{3}{4}}$	$5\frac{5}{6}$ $\underline{3\frac{2}{9}}$
20.	8 $4\frac{2}{3}$ $\underline{7\frac{1}{2}}$	$9\frac{1}{2}$ $2\frac{3}{4}$ $\underline{3\frac{2}{3}}$	$5\frac{3}{8}$ $9\frac{1}{6}$ $\underline{4\frac{2}{3}}$

Subtract:

	a	b	c
21.	$\frac{5}{6}$ $\underline{\frac{1}{6}}$	$5\frac{3}{4}$ $\underline{2\frac{1}{2}}$	$9\frac{2}{3}$ $\underline{3\frac{1}{5}}$
22.	$3\frac{1}{4}$ $\underline{1\frac{5}{8}}$	$17\frac{1}{2}$ $\underline{14\frac{5}{8}}$	$12\frac{3}{4}$ $\underline{4\frac{2}{3}}$
23.	$9\frac{1}{2}$ $\underline{3\frac{1}{3}}$	$10\frac{2}{3}$ $\underline{6\frac{1}{2}}$	6 $\underline{2\frac{2}{3}}$
24.	$8\frac{3}{4}$ $\underline{5}$	9 $\underline{3\frac{3}{5}}$	$9\frac{2}{3}$ $\underline{4\frac{5}{8}}$

25. Add $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{6}$ and subtract the sum from 1.

Review problems

1. Sue has $16.00 for a Girl Scout raincoat and a pair of boots.

How much more money does she need in order to buy these articles in the store shown above?

2. One year ago there were 67,072 telephones in use in Centerville. Now there are 70,105 telephones in use.

What is the one-year increase in the number of telephones?

3. Tom can get a baseball, a bat, and a glove for $5.95 if he buys all three together. Separately they cost $1.19, $1.69, and $3.25. How much does he save by buying all three together?

4. Every school day Mary works in the school cafeteria during each of the two lunch periods. She is paid 25 cents each lunch period.

In a school year of 39 weeks (5 days a week) she was absent from work 8 days. How much did she earn?

5. Each day that Mary works (Ex. 4) she does not have to pay for lunch. Lunch would cost her 20¢.

Counting this as part of her pay, how much does she earn in a full five-day school week?

6. The four engines of a certain airliner burn 240 gallons of gasoline in a 30-minute flight. How much would that be in a 3-hour flight?

7. If an automobile uses, on the average, 1 gallon of gasoline every 15 miles, how much gasoline would it use on a trip of 7200 miles?

8. If 24 boys share the cost of food carried on a hike and the food costs $14.88, what should be the share of each boy?

9. At lunch time 600 students go to the serving tables in 12 lines. What is the average number of students in a line?

Oral practice

Study each question and then think of an easy way to find the answer. Give a reason for each answer. The first exercise is done for you.

1. The sum of 489 and 17 is how much less than the sum of 490 and 18? Say, "I can see that 489 + 17 is 2 less than 490 + 18 because 489 is 1 less than 490, and 17 is 1 less than 18."

2. The sum of 389 and 176 is __?__ more than the sum of 387 and 174.

3. The sum of 69 and 31 is __?__ less than the sum of 72 and 34.

4. The sum of 348 and 27 is __?__ more than the sum of 346 and 25.

5. 12×25 is how much more than 10×25?

6. 9×18 is how much less than 10×18?

7. 12×15, plus __?__ $\times 15$, $= 20 \times 15$.

8. 30×12, minus __?__ $\times 12$, $= 20 \times 12$.

9. Is 6×15 equal to $\frac{12 \times 15}{2}$?

10. Does 12×6 equal 24×3?

11. Which is larger, 8×16 or 4×30?

12. $20 \times 25 = 10 \times$ __?__.

13. $100 \div 12\frac{1}{2} = 200 \div$ __?__.

14. $2.98 + $4.98 = __?__.

15. 8×35 divided by $4 \times 35 =$ __?__.

16. Is $\frac{2}{3}$ of $\frac{4}{7}$ more than $\frac{4}{7}$?

17. Which is larger, $\frac{1}{10}$ or $\frac{1}{12}$?

18. Are the numbers in this sequence increasing or decreasing: $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, $\frac{5}{6}$, etc.?

19. How much larger is $120 \div 20$ than $100 \div 20$?

20. How much smaller is $200 \div 10$ than $240 \div 10$?

21. Is $45 \div 6$ smaller than $44 \div 6$?

22. Is $51 \div 7$ twice as large as $51 \div 14$?

23. Is $17 \div \frac{2}{3}$ larger than $17 \div \frac{1}{3}$?

24. $97 \div 98$ is __?__ than 1.

25. $400 \div 399$ is __?__ than 1.

26. $12\frac{1}{2} \div \frac{7}{8}$ is __?__ than $12\frac{1}{2}$.

27. If a zero were annexed to the 12, then the product would be __?__ times as great.

$$\begin{array}{r} 12 \\ \times\, 15 \\ \hline 180 \end{array}$$

28. If a zero were annexed to the 15, then the quotient would become __?__.

$$\begin{array}{r} 160 \\ 15\overline{)2400} \end{array}$$

To the Teacher: See Note 7 on page 303.

Holding your ground

▶Oral review

1. Read: The local Community Chest reported \$125,630.75 pledged during the 10-day drive.

2. How much is \$5.78 to the nearest ten cents? What is 756 to the nearest 10?

3. Add 6, 8, 5, 4, 3, 7, and 8. Check by adding in reverse order.

4. Add 6 to each number:

1 12 23 34 45 56 67 78 89 94

5. Which is the dividend and which is the divisor in $62\overline{)576}$?

6. What is the answer in a division example called?

7. Is 62 equal to 6 tens and 2? Is it equal to 5 tens and 12?

8. How much more is 62 than 57?

9. Is 32 × 49 nearer to 1500 than to 1200? How do you know?

10. $4\overline{)18}$ $7\overline{)85}$ $6\overline{)126}$

11. $5\overline{)75}$ $9\overline{)117}$ $9\overline{)57}$

12. How would the answers to these two examples compare?

$8100 \div 90$ and $810 \div 9$

13. In the fraction $\frac{2}{3}$, the 2 is the _?_ and the 3 is the _?_.

14. $1 = \frac{?}{4}$ $\frac{2}{3} = \frac{?}{12}$ $\frac{6}{12} = \frac{?}{2}$

15. $\frac{3}{4} = \frac{?}{8}$ $\frac{1}{2} = \frac{?}{18}$ $\frac{2}{5} = \frac{?}{40}$

16. Reduce to lowest terms:

$\frac{3}{6}$ $\frac{9}{12}$ $\frac{4}{6}$ $\frac{5}{10}$ $\frac{3}{15}$ $\frac{7}{21}$

17. Change to whole or mixed numbers:

$\frac{17}{3}$ $\frac{17}{6}$ $\frac{25}{6}$ $\frac{24}{4}$ $\frac{37}{5}$

18. Change to improper fractions:

$2\frac{1}{2}$ $7\frac{2}{3}$ $3\frac{3}{4}$ $6\frac{1}{5}$ $7\frac{3}{8}$

19. Change to a better form:

$2\frac{3}{2}$ $5\frac{6}{12}$ $7\frac{11}{8}$ $4\frac{9}{4}$ $3\frac{6}{8}$

Add or subtract:

	a	*b*	*c*	*d*	*e*	*f*
20.	$\frac{3}{4} + \frac{1}{4}$	$\frac{2}{3} + \frac{2}{3}$	$\frac{7}{9} + \frac{5}{9}$	$\frac{4}{5} + \frac{3}{5}$	$\frac{7}{12} + \frac{5}{12}$	$\frac{9}{10} + \frac{3}{10}$
21.	$\frac{4}{5} - \frac{2}{5}$	$\frac{11}{12} - \frac{7}{12}$	$\frac{7}{8} - \frac{3}{8}$	$\frac{2}{3} - \frac{1}{3}$	$\frac{4}{5} - \frac{1}{5}$	$\frac{8}{10} - \frac{3}{10}$
22.	$\frac{1}{2} + \frac{1}{4}$	$\frac{5}{6} + \frac{1}{2}$	$\frac{1}{2} + \frac{1}{5}$	$\frac{1}{2} - \frac{1}{6}$	$\frac{3}{4} - \frac{1}{2}$	$\frac{1}{3} + \frac{2}{5}$

Holding your ground

Written review

1. Add and check: 97 + 83 + 64 + 95 + 83 + 64 + 97.

2. Add and check: 946 + 2985 + 764 + 38 + 724 + 8654 + 397.

3. Subtract 235 from 384.

4. Subtract $2876.49 from $5000.

5. Write this number in words: 31,571,322.

6. Write the whole numbers from 9,998 to 10,003.

7. The area of the United States including Alaska is 3,624,122 square miles. What is that to the nearest hundred thousand square miles?

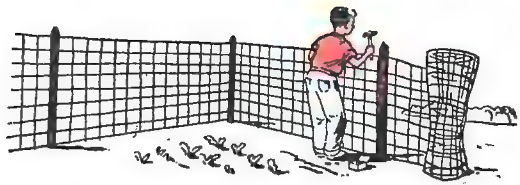
8. Mr. Miller had a balance of $38.75 in the bank last Saturday. During the week he has deposited $13.75 and $26.37 and he has written checks for $19.36, $9.45, and $13.38. What is his present balance?

9. Tom picked 17 boxes of red raspberries this morning and 15 boxes this afternoon. If he can sell them at 4 boxes for $1.30, how much will he receive for the berries?

10. $6\overline{)2584}$

11. $83\overline{)8051}$

12. Find the product of 597 and 806.



13. How much greater is 4925 than 3084?

14. 6 lb. 8 oz. = ___?___ lb.

15. 4 hr. 45 min. = ___?___ hr.

16. If the dividend is 22,761 and the quotient is 843, what is the divisor?

17. Divide $71.54 by 73.

18. Find the product of 508 and 706.

19. Add: $8\frac{5}{12} + 3\frac{3}{4} + \frac{1}{6} + 2\frac{1}{2} + 7\frac{1}{3}$.

20. Add: $4\frac{1}{2} + 6\frac{2}{3} + 7\frac{1}{6} + 2\frac{3}{4} + 9$.

21. Subtract $4\frac{5}{6}$ from 9.

22. Subtract $4\frac{5}{6}$ from $10\frac{2}{3}$.

23. What is the difference between $13\frac{2}{3}$ and $6\frac{3}{4}$?

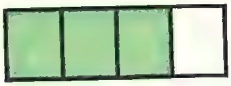
24. If eggs are 78 cents a dozen, how much will 62 dozen cost?

25. Frank's older brother is a salesman and works at a salary of $350 a month. If he can save $56 a month, how long will it take him to save $2000? (Call a fraction of a month another month)

26. What is the value of 2 tons of sweet potatoes at $2.50 a bushel if 1 bu. weighs 55 lb.? (Disregard any fractional part of a bushel)

Multiplying fractions

1. What part of this rectangle is colored? If you cover $\frac{1}{3}$ of the colored portion, what part of the whole rectangle is covered?



You have shown that $\frac{1}{3}$ of $\frac{3}{4} = \frac{1}{4}$. $\frac{1}{3}$ of $\frac{3}{4}$ and $\frac{1}{3} \times \frac{3}{4}$ mean the same thing.

2. Ex. 1 can also be done in these two ways:

- $\frac{1}{3} \times \frac{3}{4} = \frac{1 \times 3}{3 \times 4} = \frac{3}{12} = \frac{?}{4}$
- $\frac{1}{\underset{1}{\cancel{3}}} \times \frac{\overset{1}{\cancel{3}}}{4} = \frac{1 \times 1}{1 \times 4} = \frac{1}{?}$

Multiply:

3. $\frac{7}{8} \times \frac{4}{5}$ $\qquad \frac{2}{3} \times \frac{6}{10}$ $\qquad \frac{3}{4} \times \frac{5}{6}$

4. $\frac{3}{10} \times \frac{5}{6}$ $\qquad \frac{2}{5} \times \frac{3}{8}$ $\qquad \frac{1}{3} \times \frac{4}{5}$

5. The diagram below shows what is meant by $\frac{3}{4}$ of 8.

$\frac{1}{4}$ of 8 = 2

$\frac{1}{4}$ of 8 is 2, so $\frac{3}{4}$ of 8 is 3×2, or ___?___. $\frac{3}{4}$ of 8 and $\frac{3}{4} \times 8$ mean the same thing.

6. Ex. 5 can also be done in these two ways:

- $\frac{3}{4} \times \frac{8}{1} = \frac{3 \times 8}{4 \times 1} = \frac{24}{4} = \underline{\ ?\ }$
- $\frac{3}{\underset{1}{\cancel{4}}} \times \frac{\overset{2}{\cancel{8}}}{1} = \frac{3 \times 2}{1 \times 1} = \underline{\ ?\ }$

7. $\frac{1}{4} \times 12$ $\qquad \frac{1}{4} \times 14$ $\qquad \frac{2}{3} \times 18$

8. $\frac{3}{4} \times 11$ $\qquad \frac{3}{8} \times 3$ $\qquad \frac{5}{12} \times 20$

9. What is the cost of $3\frac{1}{2}$ yd. of material at 30¢ a yard? Hint: What would 3 yd. cost? $\frac{1}{2}$ yd.?

10. A mixed number and a whole number can be multiplied in two different ways. Explain the examples which follow.

- To find $6\frac{3}{4} \times 24$:

First Way

$$\begin{array}{rl} 24 & \\ \times\, 6\frac{3}{4} & \\ \hline 18 & (\frac{3}{4} \times 24) \\ 144 & \\ \hline 162 & \end{array}$$

Second Way

$$6\frac{3}{4} \times 24 =$$

$$\frac{27 \times \overset{6}{\cancel{24}}}{\underset{1}{\cancel{4}} \times 1} = 162$$

- To find $5 \times 21\frac{2}{3}$:

First Way

$$\begin{array}{rl} 21\frac{2}{3} & \\ \times\, 5 & \\ \hline 3\frac{1}{3} & (5 \times \frac{2}{3}) \\ 105 & \\ \hline 108\frac{1}{3} & \end{array}$$

Second Way

$$5 \times 21\frac{2}{3} =$$

$$\frac{5 \times 65}{1 \times 3} =$$

$$\frac{325}{3} = 108\frac{1}{3}$$

11. Do these examples the first way:

$$\begin{array}{r} 14 \\ \times\, 2\frac{1}{2} \\ \hline \end{array} \qquad \begin{array}{r} 12 \\ \times\, 7\frac{1}{4} \\ \hline \end{array} \qquad \begin{array}{r} 12\frac{3}{5} \\ \times\, 5 \\ \hline \end{array} \qquad \begin{array}{r} 12\frac{2}{3} \\ \times\, 6 \\ \hline \end{array}$$

12. Do these the second way:

$4 \times 2\frac{2}{3}$ $\qquad 28 \times 2\frac{2}{3}$ $\qquad 45 \times 3\frac{1}{5}$

Multiplying of mixed numbers

1. Kenneth needed to find the product of $\frac{5}{2}$ and $2\frac{2}{5}$. Can you do it?

2. Can you find the *mistake* in one of these multiplications?

- $5\frac{1}{3} \times 3\frac{3}{4} = \frac{\overset{4}{\cancel{16}}}{\underset{1}{\cancel{3}}} \times \frac{\overset{5}{\cancel{15}}}{\underset{1}{\cancel{4}}} = \frac{4 \times 5}{1 \times 1} = \frac{20}{1} = 20$

- $6 \times 1\frac{3}{4} = \frac{\overset{3}{\cancel{6}}}{1} \times \frac{7}{\underset{2}{\cancel{4}}} = \frac{3 \times 7}{1 \times 2} = \frac{21}{2} = 10\frac{1}{2}$

- $2\frac{2}{5} \times 10 = \frac{12}{\underset{1}{\cancel{5}}} \times \frac{\overset{2}{\cancel{10}}}{1} = \frac{12 \times 2}{2 \times 1} = \frac{24}{3} = 8$

3. Make a rule for multiplying mixed numbers. Compare your rule with the one below.

> **When you multiply mixed numbers, first change the mixed numbers to improper fractions.**

Multiply:

	a	b	c
4.	$2\frac{3}{5} \times 1\frac{1}{4}$	$6\frac{2}{3} \times 3\frac{1}{2}$	$8\frac{1}{3} \times 12\frac{3}{5}$
5.	$3 \times \frac{1}{4}$	$\frac{2}{3} \times \frac{2}{5}$	$\frac{5}{6} \times \frac{1}{2}$
6.	$\frac{2}{3} \times \frac{3}{2}$	$\frac{4}{5} \times \frac{5}{4}$	$2\frac{2}{3} \times 3$
7.	$\frac{2}{5} \times \frac{5}{6}$	$\frac{5}{8} \times \frac{4}{5}$	$2\frac{1}{4} \times \frac{1}{3}$
8.	$\frac{8}{9} \times \frac{15}{16}$	$1\frac{1}{2} \times \frac{2}{3}$	$9 \times 1\frac{1}{3}$
9.	$9 \times 1\frac{2}{3}$	$2\frac{2}{3} \times 1\frac{1}{3}$	$5 \times 3\frac{1}{5}$
10.	$2\frac{1}{5} \times 3\frac{1}{8}$	$1\frac{2}{3} \times \frac{3}{5}$	$5\frac{1}{3} \times \frac{3}{16}$

11. Estimate whether $3\frac{7}{8} \times 4\frac{5}{6}$ is closer to 12, or to 15, or to 20. How can you tell?

12. A cake recipe calls for $\frac{3}{4}$ cup of butter. Since Mrs. Turner wants to make only $\frac{2}{3}$ of the amount of cake the recipe calls for, how much butter should she use?

13. The camping committee of the Indian Club estimated they would need $1\frac{3}{4}$ lb. of bacon per day for their camping trip. How much would they need for a 14-day trip?

14. Dick wanted to make 8 wooden stakes to use in his garden. Each stake was to be $2\frac{3}{4}$ ft. long. He had a wooden pole 24 feet long, which he decided would make good stakes.

After he cut off the 8 stakes, how long a piece did he have left?

15. Mary uses $1\frac{1}{2}$ teaspoons of sugar for each cup of hot chocolate. When she makes 9 cups at once, how much sugar should she use?

16. The Ford family uses $2\frac{1}{2}$ dozen eggs each week. What is the cost when eggs are 78 cents a dozen?

17. When cheese is 76 cents a pound, a piece weighing 12 ounces will cost _?_ ¢.

18. The candy committee made fudge and weighed out 75 bags of $\frac{1}{8}$ pound each. They had _?_ pounds of fudge in all.

Dividing by a unit fraction

1. Jane has six yards of paper streamer which she wants to divide into $\frac{1}{2}$-yard lengths. How many $\frac{1}{2}$-yard pieces of streamer can she get from 6 yards of streamer?

$6 \div \frac{1}{2} = 6 \times 2 = \underline{\ ?\ }$

2. Do these two questions mean the same thing?

- How many 3's are there in 12?
- $12 \div 3 = \underline{\ ?\ }$

3. What is another way of asking how many $\frac{1}{2}$ inches there are in 8 in.?

4. $7 \div \frac{1}{2} = \underline{\ ?\ }$. Think: How many $\frac{1}{2}$ inches are there in 1 inch? in 7 inches? Use a ruler to prove your answer.

5. How many $\frac{1}{4}$ in. are there in 1 in.? in 3 in.? $3 \div \frac{1}{4} = \underline{\ ?\ }$

Do the following examples mentally. Draw a diagram if you need to.

	a	*b*	*c*
6.	$8 \div \frac{1}{4}$	$7 \div \frac{1}{3}$	$3 \div \frac{1}{8}$
7.	$9 \div \frac{1}{2}$	$7 \div \frac{1}{5}$	$6 \div \frac{1}{5}$
8.	$6 \div \frac{1}{4}$	$5 \div \frac{1}{6}$	$2 \div \frac{1}{16}$

9. An easy way to *divide* a number by $\frac{1}{2}$ is to *multiply* it by 2.

$5 \div \frac{1}{2} = 5 \times 2 = \underline{\ ?\ }$

10. To *divide* a number by $\frac{1}{3}$, you *multiply* it by $\underline{\ ?\ }$.

$8 \div \frac{1}{3} = 8 \times 3 = \underline{\ ?\ }$

11. When you were asked to divide a number by $\frac{1}{2}$, you found the answer by multiplying the number by 2.

When you were asked to divide a number by $\frac{1}{4}$, you found the answer by multiplying by $\underline{\ ?\ }$.

To divide by $\frac{1}{5}$, multiply by $\underline{\ ?\ }$.

12. A *unit fraction* is a fraction whose numerator is 1. The unit fraction $\frac{1}{2}$ inverted (turned upside down) is $\frac{2}{1}$ or 2; $\frac{1}{3}$ inverted is $\frac{3}{1}$ or 3; $\frac{1}{4}$ inverted is $\underline{\ ?\ }$; $\frac{1}{5}$ inverted is $\underline{\ ?\ }$.

13. Does $6 \div \frac{1}{4} = 6 \times \frac{4}{1} = 24$?

14. Tell how you would divide 9 by $\frac{1}{2}$; by $\frac{1}{3}$; by $\frac{1}{4}$; by $\frac{1}{5}$.

15. Make a rule for dividing a number by a unit fraction.

16. Does your rule agree with the one given here?

> **To divide a number by a unit fraction, invert the fraction and multiply.**

	a	*b*	*c*
17.	$5 \div \frac{1}{2}$	$7 \div \frac{1}{6}$	$6 \div \frac{1}{3}$
18.	$4 \div \frac{1}{5}$	$15 \div \frac{1}{2}$	$17 \div \frac{1}{8}$
19.	$9 \div \frac{1}{7}$	$5 \div \frac{1}{4}$	$2 \div \frac{1}{6}$

20. How many half-pint cartons can you fill with 1 pint of milk? with 2 pints? 3 pints? 4 pints? 5 pints?

Dividing by a fraction or a mixed number

Now that you have a rule for dividing by a unit fraction, let's see if you can discover a similar rule for dividing by any fraction.

1. Use your ruler to find out how many $\frac{3}{4}$ inches there are in 3 inches. Your answer is _?_.

You have shown that $3 \div \frac{3}{4} =$ _?_.

You will get the same answer if you invert the $\frac{3}{4}$ and multiply.

$$3 \div \frac{3}{4} = \overset{1}{\cancel{3}} \times \frac{4}{\underset{1}{\cancel{3}}} = \underline{\ ?\ }.$$

To *divide* a number by $\frac{3}{4}$, you multiply it by $\frac{4}{3}$.

2. Now use your ruler to find out how many $1\frac{1}{2}$ inches there are in 3 in. Your answer is _?_.

You have shown that:

$$3 \div 1\frac{1}{2} = 3 \div \frac{3}{2} = \overset{1}{\cancel{3}} \times \frac{2}{\underset{1}{\cancel{3}}} = \underline{\ ?\ }.$$

To *divide* a number by $1\frac{1}{2}$, you first change the $1\frac{1}{2}$ to $\frac{3}{2}$ and multiply the number by $\frac{2}{3}$.

3. Make a rule for dividing a number by any fraction or by a mixed number.

4. Does your rule agree with the one given below?

> **To divide by a fraction, invert the divisor and multiply. If you are dividing by a mixed number, first change it to an improper fraction.**

5. $\frac{2}{3}$ inverted is $\frac{3}{2}$.
$\frac{3}{4}$ inverted is _?_.
$\frac{4}{5}$ inverted is _?_.
$\frac{7}{3}$ inverted is _?_.

6. Study these division examples:

- $8 \div \frac{3}{4} = 8 \times \frac{4}{3} = \frac{32}{3} = 10\frac{2}{3}$
- $\frac{5}{12} \div \frac{3}{4} = \frac{5}{\underset{3}{\cancel{12}}} \times \frac{\overset{1}{\cancel{4}}}{3} = \frac{5}{9}$
- $\frac{5}{7} \div 3 = \frac{5}{7} \times \frac{1}{3} = \frac{5}{21}$
- $4\frac{2}{5} \div 2\frac{1}{5} = \frac{22}{5} \div \frac{11}{5} = \frac{\overset{2}{\cancel{22}}}{\underset{1}{\cancel{5}}} \times \frac{\overset{1}{\cancel{5}}}{\underset{1}{\cancel{11}}} = 2$

Divide:

	a	*b*	*c*
7.	$\frac{1}{8} \div \frac{2}{3}$	$1\frac{2}{3} \div \frac{5}{3}$	$\frac{5}{7} \div 1\frac{1}{3}$
8.	$\frac{3}{4} \div \frac{3}{2}$	$1\frac{2}{3} \div \frac{1}{3}$	$\frac{3}{4} \div 1\frac{1}{2}$
9.	$3 \div \frac{1}{4}$	$\frac{2}{3} \div \frac{2}{5}$	$\frac{5}{6} \div 2$
10.	$\frac{2}{3} \div \frac{2}{3}$	$\frac{4}{5} \div \frac{4}{5}$	$5 \div \frac{1}{5}$
11.	$3\frac{1}{3} \div 1\frac{2}{3}$	$1\frac{2}{3} \div 2\frac{1}{2}$	$\frac{3}{4} \div \frac{2}{3}$
12.	$\frac{3}{8} \div \frac{5}{4}$	$1\frac{2}{3} \div \frac{10}{11}$	$\frac{3}{8} \div 3$
13.	$3\frac{3}{4} \div \frac{5}{4}$	$6\frac{2}{3} \div 1\frac{1}{3}$	$7\frac{1}{2} \div 1\frac{1}{4}$

14. Jane said that $12 \div 1\frac{7}{8}$ would be about equal to $12 \div 2$, or 6. Explain.

15. Do the division $12 \div 1\frac{7}{8}$ and see how close Jane's estimate was in Ex. 14.

Things you should know about division

1. The divisions in the box show something interesting about divisors and quotients.

64	÷	4	=	16
64	÷	2	=	32
64	÷	1	=	64
64	÷	$\frac{1}{2}$	=	128
64	÷	$\frac{1}{4}$	=	?
64	÷	?	=	?

Do you see any relation? If so, you can tell the missing numbers. Can you?

2. Bill said, "If you don't change the dividend, and if you make the divisor half as large, then your quotient will be ___?___ as large."

3. Bill gave this example of the principle in Exs. 1–2:

If you have \$64 and spend \$4 a day the money will last 16 days; but if you spend only \$2 a day it will last twice as long, or ___?___ days.

How long will the \$64 last if you spend \$1 a day? \$$\frac{1}{2}$? \$$\frac{1}{4}$? \$$\frac{1}{8}$?

4. Give another illustration of the same principle. Start this way:⟶

40	÷	5	=	?
40	÷	$2\frac{1}{2}$	=	?
40	÷	$1\frac{1}{4}$	=	?
40	÷	?	=	?

5. Jane was thinking about this same idea.

"I wonder if the idea would work with fractional dividends, such as these?" she asked. Does it?

$\frac{1}{2}$	÷	$\frac{1}{8}$	=	4
$\frac{1}{2}$	÷	$\frac{1}{16}$	=	?
$\frac{1}{2}$	÷	$\frac{1}{32}$	=	?
$\frac{1}{2}$	÷	?	=	?

6. Can you tell what principle these two examples illustrate?

- $2\frac{1}{2}$ is contained in $2\frac{1}{2}$ once.
- $7\frac{3}{4}$ is contained in $7\frac{3}{4}$ once.

7. Does the principle in Ex. 6 agree with this one?

▶ Any number divided by itself is 1.

8.

$12 \div 4 = 3$	$4 \div 12 = \frac{1}{3}$
$20 \div 5 = 4$	$20 \div 1 = 20$
$20 \div \frac{1}{5} = 100$	$20 \div \frac{5}{6} = 24$

Tell which of the above examples illustrate each of the following principles. Explain.

▶ If the divisor is larger than 1, the quotient will be smaller than the dividend.

▶ If the divisor is smaller than 1, the quotient will be larger than the dividend.

▶ If the divisor is larger than the dividend, the quotient will be a fraction.

▶ The dividend may be either smaller or larger than the quotient.

9. First tell which of the following solutions seem sensible to you according to the five principles stated above.

$6 \div \frac{1}{2} = 3$	$64 \div \frac{4}{5} = 80$	$\frac{1}{2} \div \frac{1}{2} = \frac{1}{4}$
$\frac{1}{2} \div \frac{5}{8} = \frac{4}{5}$	$42 \div 7 = 6$	$5 \div 15 = 3$
$15 \div \frac{1}{5} = 75$	$4\frac{3}{7} \div 4\frac{3}{7} = 1$	$6 \div 24 = \frac{1}{4}$

Then tell which principle is illustrated by each example. Are there any solutions which do not agree with any of the principles?

Practice with fractions

1. Reduce to lowest terms:

$\frac{3}{6}$ $\qquad$ $\frac{6}{8}$ $\qquad$ $\frac{8}{12}$ $\qquad$ $\frac{5}{10}$ $\qquad$ $\frac{3}{9}$ $\qquad$ $\frac{4}{16}$ $\qquad$ $\frac{6}{12}$ $\qquad$ $\frac{12}{12}$ $\qquad$ $\frac{18}{24}$ $\qquad$ $\frac{15}{27}$

2. Change to whole or mixed numbers:

$\frac{5}{5}$ $\qquad$ $\frac{4}{3}$ $\qquad$ $\frac{6}{5}$ $\qquad$ $\frac{7}{3}$ $\qquad$ $\frac{20}{5}$ $\qquad$ $\frac{9}{9}$ $\qquad$ $\frac{32}{5}$ $\qquad$ $\frac{18}{7}$ $\qquad$ $\frac{26}{3}$ $\qquad$ $\frac{65}{7}$

3. Tell the missing numerators:

$\frac{1}{3} = \frac{?}{9}$ $\qquad$ $\frac{3}{4} = \frac{?}{12}$ $\qquad$ $\frac{1}{4} = \frac{?}{20}$ $\qquad$ $\frac{2}{3} = \frac{?}{12}$ $\qquad$ $\frac{5}{9} = \frac{?}{18}$

4. Change to improper fractions:

$3\frac{1}{2}$ $\qquad$ $5\frac{1}{2}$ $\qquad$ $6\frac{1}{4}$ $\qquad$ $8\frac{3}{4}$ $\qquad$ $4\frac{1}{3}$ $\qquad$ $5\frac{2}{3}$ $\qquad$ $6\frac{1}{5}$ $\qquad$ $3\frac{2}{5}$

5. Do these as addition examples; then as subtraction examples:

$\begin{array}{r}\frac{7}{8}\\ \frac{6}{8}\\ \hline\end{array}$ $\qquad$ $\begin{array}{r}4\frac{1}{3}\\ 3\frac{1}{4}\\ \hline\end{array}$ $\qquad$ $\begin{array}{r}5\frac{1}{2}\\ 3\frac{2}{3}\\ \hline\end{array}$ $\qquad$ $\begin{array}{r}\frac{5}{12}\\ \frac{2}{12}\\ \hline\end{array}$ $\qquad$ $\begin{array}{r}\frac{1}{2}\\ \frac{1}{3}\\ \hline\end{array}$ $\qquad$ $\begin{array}{r}\frac{3}{4}\\ \frac{2}{3}\\ \hline\end{array}$ $\qquad$ $\begin{array}{r}6\frac{2}{3}\\ 4\frac{1}{2}\\ \hline\end{array}$ $\qquad$ $\begin{array}{r}\frac{3}{4}\\ \frac{2}{5}\\ \hline\end{array}$

6. $5 = \frac{?}{2}$ $\qquad$ $8 = \frac{?}{3}$ $\qquad$ $5\frac{1}{2} = 4\frac{?}{2}$ $\qquad$ $6\frac{7}{8} = 5\frac{?}{8}$

7. $\frac{3}{8} \times 4\frac{1}{3}$ $\qquad$ $8 \times 2\frac{2}{3}$ $\qquad$ $12 \div 1\frac{1}{2}$ $\qquad$ $5\frac{2}{5} \div 2\frac{1}{10}$

8. $4\frac{4}{5} \times 2\frac{1}{12}$ $\qquad$ $7\frac{1}{2} \div \frac{3}{4}$ $\qquad$ $\frac{1}{3} \times \frac{3}{4}$ $\qquad$ $\frac{3}{4} \div 6$

9. How many $\frac{3}{4}$-hour periods are there in $4\frac{1}{2}$ hours?

10. Show by means of a ruler graduated to sixteenths of an inch how each of these examples can be done:

$2\frac{7}{8} + \frac{1}{4}$ $\qquad$ $3\frac{1}{8} - \frac{3}{16}$ $\qquad$ $6 \div \frac{3}{4}$

11. What is $\frac{1}{2}$ of $7\frac{1}{2}$ cups?

12. If you measure $\frac{3}{4}$ of a foot three times in succession in a straight line, how long will the line be?

13. What do six boxes of crackers cost at $7\frac{1}{2}$ cents a box?

14. If butter costs 89 cents a pound, how much must you pay for $2\frac{1}{2}$ pounds?

15. Jane picked up a bunch of bananas and handed them to a clerk. He said, "$3\frac{3}{4}$ pounds, 60 cents." What was the price of one pound of these bananas?

16. What is the cost of $3\frac{5}{8}$ yd. of rayon at 79 cents a yard?

17. Frank and his father drove 349 miles in $9\frac{3}{4}$ hours. What was their average rate of speed to the nearest mile per hour?

Review

Multiply as indicated:

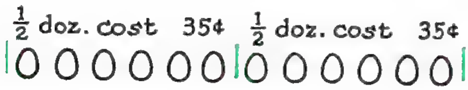
	a	b	c	d
1.	$12 \times \frac{3}{4}$	$\frac{3}{4} \times 4$	$\frac{1}{2} \times 10$	$\frac{2}{3} \times 4$
2.	$2 \times \frac{5}{6}$	$8 \times \frac{2}{3}$	$6 \times \frac{4}{15}$	$24 \times \frac{3}{4}$
3.	$\frac{2}{3} \times \frac{5}{9}$	$\frac{2}{3} \times \frac{3}{4}$	$\frac{2}{3} \times \frac{5}{6}$	$\frac{3}{4} \times \frac{8}{15}$
4.	$5 \times 4\frac{1}{2}$	$6 \times 3\frac{1}{3}$	$6\frac{2}{3} \times 9$	$6\frac{2}{3} \times 8$
5.	$2\frac{1}{2} \times 1\frac{1}{2}$	$5\frac{1}{4} \times 4\frac{2}{3}$	$2\frac{1}{4} \times 7\frac{1}{2}$	$5\frac{5}{6} \times 4\frac{4}{5}$
6.	$2\frac{2}{3} \times 2\frac{3}{4}$	$5\frac{3}{4} \times 2\frac{4}{5}$	$2\frac{1}{2} \times 3\frac{2}{3}$	$\frac{3}{8} \times 2\frac{1}{2}$
7.	$20 \times \frac{3}{5}$	$\frac{3}{5} \times 7$	$4 \times 2\frac{3}{8}$	$\frac{2}{3} \times 18$
8.	$5\frac{2}{3} \times 6\frac{3}{4}$	$8\frac{1}{3} \times 2\frac{1}{2}$	$\frac{4}{5} \times 6\frac{2}{3}$	$8\frac{1}{2} \times 2$

Divide as indicated:

	a	b	c	d
9.	$9 \div \frac{3}{4}$	$\frac{3}{4} \div 1$	$5 \div \frac{1}{2}$	$2\frac{2}{3} \div 4$
10.	$1\frac{2}{3} \div 2$	$5\frac{1}{3} \div 8$	$1\frac{1}{5} \div 6$	$18 \div \frac{3}{4}$
11.	$\frac{10}{27} \div \frac{5}{9}$	$\frac{1}{2} \div \frac{2}{3}$	$\frac{5}{9} \div \frac{2}{3}$	$\frac{2}{5} \div \frac{3}{4}$
12.	$22\frac{1}{2} \div 4\frac{1}{2}$	$20 \div 3\frac{1}{3}$	$60 \div 6\frac{2}{3}$	$53\frac{1}{3} \div 8$
13.	$3\frac{3}{4} \div 2\frac{1}{2}$	$24\frac{1}{2} \div 4\frac{2}{3}$	$16\frac{7}{8} \div 7\frac{1}{2}$	$46\frac{2}{3} \div 8$
14.	$7\frac{1}{3} \div 2\frac{3}{4}$	$16\frac{1}{10} \div 5\frac{3}{4}$	$9\frac{1}{6} \div 3\frac{2}{3}$	$\frac{15}{16} \div 2\frac{1}{2}$
15.	$12 \div \frac{3}{5}$	$4\frac{1}{5} \div 7$	$9\frac{1}{2} \div 4$	$12 \div \frac{2}{3}$
16.	$38\frac{1}{4} \div 5\frac{2}{3}$	$20\frac{5}{6} \div 8\frac{1}{3}$	$5\frac{1}{3} \div \frac{4}{5}$	$17 \div \frac{17}{2}$

Finding a whole when part of it is known

1. If $\frac{1}{2}$ doz. eggs cost 35¢, what will a dozen cost at the same rate?



$2 \times \frac{1}{2}$ doz. = 1 doz.
$2 \times 35¢ =$ __?__ ¢
1 doz. eggs cost __?__ ¢

Draw lines to help you answer these questions:

2. If $\frac{1}{2}$ of a line is 3 in., how long is the line?

3. If $\frac{1}{2}$ of a number is 24, what is the number?

4. If $\frac{1}{5}$ of a line is 6 inches, how long is the line?

5. If $\frac{1}{4}$ of a line is 20 in., how long is the line?

6. If $\frac{1}{4}$ of a number is 12, what is the number?

7. If $\frac{1}{3}$ of a number is 6, what is the number?

8. If 4 boys are $\frac{1}{3}$ the number needed for traffic duty, how many are needed in all?

9. A box of candy marked $\frac{1}{2}$ lb. sells for 48¢. A whole pound at that rate will cost __?__ ¢.

10. Make and illustrate a rule for finding a number when you know $\frac{1}{2}$ of it; $\frac{1}{3}$ of it; $\frac{1}{8}$ of it; $\frac{1}{10}$ of it.

11. Harry sells brushes in his spare time and is allowed to keep $\frac{2}{5}$ of the amount of his sales.

How many dollars worth of brushes must he sell in a week in order to earn $10? This is the way Harry found out:

▶ First Harry thought, "I know that I can keep $\frac{2}{5}$ of all the money I take in. The whole number of dollars I have to take in is $\frac{5}{5}$."

He drew a line and marked off on it 5 equal spaces, as shown here, to represent $\frac{5}{5}$, or the whole number of dollars he would have to take in.

▶ Next he thought, "I know that $\frac{2}{5}$ of the whole number of dollars is $10." So he marked off $\frac{2}{5}$ of the line and labeled that $10. His line then looked like this:

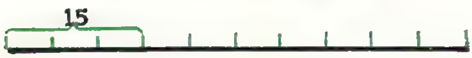
▶ Then he thought, "If 2 parts of the line represent $10, 1 part represents $5; so 5 parts represent 5 × $5, or $25."

▶ So Harry would have to sell __?__ dollars worth of brushes in a week to earn $10.

12. Three tenths of a number is 15; what is the number? Use Harry's method to find out. Think:

▶ $\frac{3}{10}$ of a number is 15. $\frac{10}{10}$ represents the whole number. Imagine a line like the one shown here:

▶ Three spaces on the line are $\frac{3}{10}$ of the line and represent 15.



▶ If $\frac{3}{10}$ of the line equals 15, $\frac{1}{10}$ of it equals 5, and $\frac{10}{10}$ of it equals 50. So the number is _?_.

13. Tom has set out 5 cabbages. This is $\frac{1}{4}$ the number he has to plant. In all he has to plant _?_.

14. If $\frac{3}{4}$ of an hour's music lesson costs \$3.00, what will an hour's lesson cost at the same rate?

15. If $\frac{3}{4}$ of a number is 24, what is the number?

16. If $\frac{2}{3}$ of a line is 12 in., how long is the line?

17. If $\frac{2}{3}$ of a number is 18, what is the number?

18. Make and illustrate a rule for finding a number when you know $\frac{2}{3}$ of it; $\frac{3}{4}$ of it; $\frac{2}{5}$ of it; $\frac{5}{8}$ of it.

19. Tell what the number is when:

$\frac{2}{3}$ of it is 30	$\frac{3}{5}$ of it is 21
$\frac{3}{4}$ of it is 9	$\frac{5}{6}$ of it is 20

20. If $\frac{3}{4}$ of a yard of ribbon costs 21 cents, a yard will cost _?_.

21. When 10 boys in Room 7 signed up for swimming, that was half the boys. How many boys were there in Room 7?

22. In one month Joy used \$6 to buy savings stamps. She said that was $\frac{3}{4}$ of what she earned that month. How much did she earn?

23. When Ann pays 10¢ for $\frac{1}{4}$ lb. of nut meats, she is paying at the rate of _?_ per pound.

24. Mary said, "I bought this jar of cheese for 20¢." Her mother said, "The jar is marked 4 ounces. One pound at that rate would cost _?_."

25. If 3 oranges cost 20¢, what will a dozen cost at the same rate?

26. If 4 pencils cost 9 cents, what will 12 pencils cost?

27. When 4 lemons cost 20 cents, a dozen lemons will cost _?_ cents.

28. By paying cash Bill got $\frac{1}{10}$ off the price of a radio and saved \$4.50. What was the regular price of the radio?

29. When the rent was increased to \$60 a month, Mr. Carr said, "That is $\frac{1}{4}$ of what I earn in a month." How much did he earn in a month?

30. The price per year for a two-year subscription to Boys Magazine is $\frac{4}{5}$ of the one-year price.

Jim sends \$8 for the two years. What is the one-year price?

Fractions

▶ Group 1

If you need help in answering Exs. 1–10, you may refer to the diagrams below:

1. Is $\frac{1}{2}$ of a pie plus $\frac{1}{4}$ of a pie as much as a whole pie?

2. Is $\frac{3}{4} + \frac{1}{2}$ more or less than 1?

3. How many fourths does it take to make 1 half?

4. How many eighths does it take to make 1 fourth?

5. How many eighths does it take to make 3 fourths?

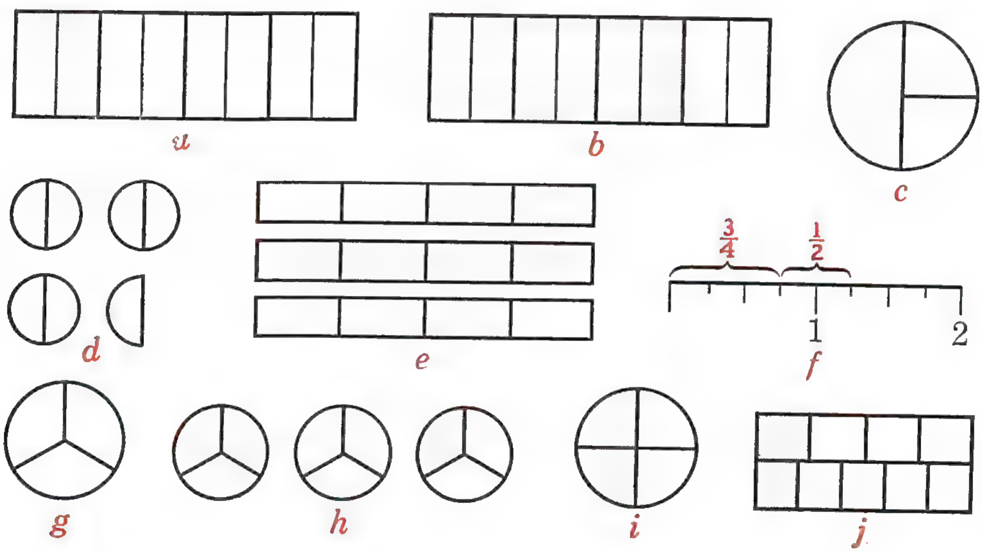
6. How many thirds are there in 1 whole?

7. How many thirds are there in $2\frac{1}{3}$?

8. Which is larger $\frac{1}{4}$ or $\frac{1}{5}$?

9. Is $\frac{11}{4}$ more, or less than 3?

10. How many wholes are there in 7 halves?



	a	*b*	*c*	*d*
11.	Reduce: $\frac{3}{9}$	$\frac{3}{4} = \frac{?}{8}$	$\frac{1}{2} + \frac{1}{4}$	$3\frac{1}{2} + 2\frac{1}{4}$
12.	$\frac{1}{2} + \frac{3}{4}$	$3\frac{1}{2} + 2\frac{3}{4}$	$\frac{1}{2} - \frac{1}{4}$	$4\frac{1}{2} - 2\frac{1}{4}$
13.	$\frac{1}{2}$ of $\frac{1}{2}$ = ?	$2 \times 3\frac{1}{2}$ = ?	$6 \div \frac{1}{2}$ = ?	$6 \div \frac{3}{4}$ = ?

To the Teacher: See Note 8 on page 303.

Fractions

Group 2

1. If Frank eats $\frac{1}{2}$ of a pie, Fred eats $\frac{1}{4}$ of it, and Mary eats $\frac{1}{8}$ of it, how much is left for Ann?

2. Count by $\frac{1}{4}$'s to 3. ($\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, 1, $1\frac{1}{4}$, etc.)

3. Count by $\frac{1}{8}$'s to 2.

4. What common denominator would you use in adding $\frac{1}{2}$, $\frac{2}{3}$, and $\frac{3}{4}$?

5. What common denominator would you use in adding $\frac{2}{3}$ and $\frac{3}{5}$?

6. How can you recognize an improper fraction by just looking at it?

7. Which is larger $\frac{15}{16}$ or $\frac{3}{4}$?

8. Six and $\frac{2}{3}$ equals 5 and $\frac{?}{3}$.

9. Which answer is nearest for $3\frac{1}{3} \times 5\frac{1}{2}$? 30 16 3

10. Is $6 \div \frac{3}{4}$ more, or less, than 6?

11. Reduce $\frac{18}{24}$ to lowest terms.

12. Change $\frac{32}{6}$ to a mixed number.

13. $\frac{3}{5} = \frac{?}{20}$.

14. Change $3\frac{2}{3}$ to an improper fraction.

15. Add $\frac{3}{4}$ and $\frac{5}{6}$.

16. Add $5\frac{1}{2}$ and $7\frac{2}{3}$.

17. Subtract $7\frac{1}{2}$ from $13\frac{5}{6}$.

18. Subtract $7\frac{5}{6}$ from $13\frac{1}{2}$.

19. $7\frac{1}{2} \times 1\frac{3}{5} = \underline{\ ?\ }$

20. $7\frac{1}{2} \div \frac{3}{7} = \underline{\ ?\ }$

21. How much larger is $6 \times 7\frac{1}{2}$ than $5 \times 7\frac{1}{2}$?

22. How much larger is 5×8 than $4\frac{1}{2} \times 8$?

23. If $2\frac{3}{4} + 1\frac{3}{8}$ is $4\frac{1}{8}$, then $2\frac{3}{4} + 1\frac{1}{2}$ is $\underline{\ ?\ }$.

24. To find the quotient of $900 \div 36$ Tom thought: "$900 \div 9 = 100$; $100 \div 4 = 25$." Was his thinking correct?

25. Use Tom's method (Ex. 24) to divide 468 by 12.

26. $3\frac{1}{2} \times 6\frac{1}{4} = 3 \times 6\frac{1}{4}$ plus $\frac{1}{2}$ of 6, plus $\frac{1}{2}$ of $\underline{\ ?\ }$.

27. $4\frac{1}{2} \times 5\frac{3}{4} = 4 \times 5\frac{3}{4} + \frac{1}{2}$ of $\underline{\ ?\ }$, plus $\frac{1}{2}$ of $\underline{\ ?\ }$.

28. Reduce $\frac{16}{64}$ to lowest terms.

29. Add $\frac{7}{8}$ and $\frac{13}{24}$.

30. $5\frac{1}{3} \times 7\frac{5}{8} = \underline{\ ?\ }$.

▶ Group 3

1. Explain a method for each of the following:

a Reducing a fraction to lowest terms.
b Changing a fraction to an equivalent fraction with a large denominator.
c Changing improper fractions to whole or mixed numbers.
d Changing a mixed number to an improper fraction.
e Finding the common denominator of three fractions when the common denominator is not one of the given denominators.
f Subtracting $2\frac{3}{4}$ from $5\frac{1}{2}$.
g Multiplying a mixed number by a mixed number.
h Dividing a mixed number by a mixed number.

2. When you divide one number by another under what circumstances is the quotient larger than 1?

3. How much is $\frac{1}{2} \div \frac{1}{2}$?

4. If $\frac{3}{4}$ of a number is 24, what is the number?

5. If $\dfrac{N}{\frac{1}{2}} = 6$, what is N?

6. If $\dfrac{12}{N} = 3$, what is N?

7. $\frac{3}{4}$ of $24 = \frac{1}{2}$ of $24 + \underline{\ ?\ }$ of 24.

8. Add: $2\frac{1}{2} + 3\frac{5}{8} + 4\frac{5}{6}$

9. Subtract $9\frac{5}{6}$ from $14\frac{3}{4}$.

10. $16\frac{1}{2} \div 3\frac{3}{4} = \underline{\ ?\ }$

11. $240 \times 3\frac{1}{2} = \underline{\ ?\ }$

12. Is $13\frac{15}{32}$ nearest to 13, $13\frac{1}{2}$, or 14?

In the following examples tell which of these statements are (a) never true (b) always true, or (c) sometimes true:

13. Reducing a fraction to lowest terms makes it smaller.

14. Dividends are larger than their divisors.

15. If the divisor is a proper fraction, the quotient is larger than the dividend.

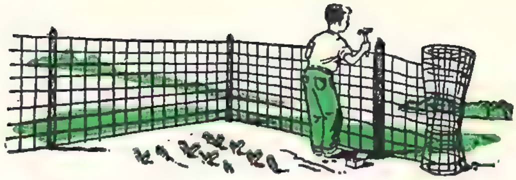
16. If the divisor is a mixed number the quotient will be a mixed number.

17. The quotient times the divisor equals the dividend minus the remainder.

18. The dividend divided by the quotient equals the divisor.

19. If the dividend is some number of dollars, then the quotient is some number of dollars.

Holding your ground



▶ Oral review

1. Divide. Reduce fractions in your answers to lowest terms.

$8\overline{)24}$	$8\overline{)37}$	$8\overline{)54}$	$8\overline{)57}$
$8\overline{)50}$	$8\overline{)43}$	$8\overline{)47}$	$8\overline{)61}$

2. 5 feet are how many inches?

3. 16 pints are how many quarts?

4. In a scale drawing, how long a line will you have to draw to indicate 5 feet if the scale is $\frac{1}{4}$ inch to a foot?

5. Read: 2,008,672

6. What number is this: CXIX?

7. On a bar graph, if a line $7\frac{1}{2}$ units long represents 1500 bushels, what will a line 15 units long represent?

8. Find the product of 60 and 7.

9. 48 qt. = __?__ gal.

10. 24 da. = __?__ wk.

11. 4 lb. 5 oz. = __?__ oz.

12. Change to mixed numbers:

$\frac{13}{5}$ $\qquad \frac{22}{5}$ $\qquad \frac{62}{8}$ $\qquad \frac{31}{4}$ $\qquad \frac{19}{6}$

13. Reduce to lowest terms:

$\frac{8}{12}$ $\qquad \frac{9}{15}$ $\qquad \frac{10}{24}$ $\qquad \frac{15}{18}$ $\qquad \frac{24}{32}$

14. Tell the missing numbers:

$\frac{2}{3} = \frac{?}{15}$ $\qquad \frac{1}{6} = \frac{?}{12}$ $\qquad 4\frac{1}{6} = 3\frac{?}{6}$

15. What is 984,244 to the nearest million?

	a	*b*
16.	$\frac{1}{4} + \frac{1}{5}$	$\frac{7}{8} - \frac{1}{3}$
	$2\frac{1}{2} - 1\frac{1}{4}$	$\frac{2}{3} \times \frac{5}{7}$
17.	$\frac{1}{5} - \frac{1}{6}$	$1\frac{1}{2} + 2\frac{1}{4}$
	$7 \times \frac{1}{4}$	$\frac{2}{3} \times 6$

18. If you know the cost of one can of peas and you wish to find the cost of several cans, should you add, subtract, multiply or divide?

19. If you know the cost of a football and how much money you have, to find how much more you need in order to buy it, you should __?__.

20. If you know the cost of an article and wish to find how many articles of this kind you can buy for a certain sum of money, you should __?__.

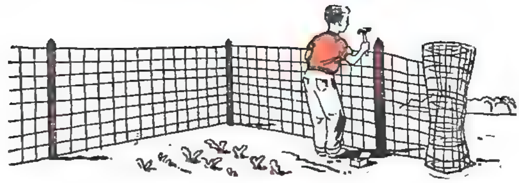
21. When numbers to be added are the same, you save time by __?__.

22. Add to the right and check by adding to the left:

7 9 8 3 4 5 6

23. Multiply and then add 5:

8×7	6×8	8×8	8×9
9×7	6×9	9×6	7×7
9×9	7×8	9×8	7×9



Holding your ground

▶ Written review

Add:

	a	b	c	d	e
1.	98324 9362 95782 63107	93574 23214 82837 94468	73943 85182 66568 27149	62939 53148 30877 60259	75321 46587 95243 36842
2.	$4\frac{3}{16}$ $2\frac{1}{2}$ $3\frac{1}{4}$	$5\frac{1}{2}$ $3\frac{2}{3}$ $\frac{3}{4}$	$3\frac{3}{8}$ $2\frac{1}{3}$ $4\frac{1}{2}$	$7\frac{1}{8}$ $4\frac{2}{3}$ $5\frac{1}{6}$	$5\frac{2}{5}$ $8\frac{1}{6}$ $2\frac{1}{10}$

Subtract:

	a	b	c	d	e
3.	74856 13455 61401	71610 12265 5	39037 19654	40000 28995	93273 38594
4.	$3\frac{3}{4}$ $1\frac{1}{3}$	$4\frac{1}{2}$ $2\frac{2}{3}$	7 $5\frac{3}{8}$	$9\frac{1}{6}$ $4\frac{3}{4}$	$6\frac{5}{6}$ $2\frac{3}{4}$

Multiply:

	a	b	c	d	e
5.	3241 × 7	8645 × 6	9816 × 8	7931 × 9	6593 × 5
6.	798 × 38	872 × 78	874 × 48	749 × 39	496 × 76
7.	576 × 405	496 × 540	850 × 807	679 × 506	567 × 308
8.	8733 × 5	658 × 57	547 × 800	439 × 760	329 × 46

Divide:

	a	b	c	d	e
9.	$6\overline{)1764}$	$7\overline{)5894}$	$9\overline{)2781}$	$8\overline{)7304}$	$5\overline{)1240}$
10.	$81\overline{)1863}$	$59\overline{)2773}$	$77\overline{)6468}$	$24\overline{)10416}$	$37\overline{)34151}$

Self-Help Test 1

The number at the right of each example tells you the page on which you can find help for that kind of example.

1. Reduce to lowest terms:

$\frac{9}{12}$ $\frac{10}{15}$ $\frac{16}{24}$ $\frac{14}{18}$ (65)

2. Tell the missing numerators:

$\frac{3}{4} = \frac{?}{24}$ $\frac{5}{6} = \frac{?}{24}$ $\frac{7}{8} = \frac{?}{24}$ (65)

3. Change to a whole number or mixed number:

$\frac{10}{9}$ $\frac{12}{4}$ $\frac{23}{8}$ $\frac{42}{4}$ $\frac{50}{5}$ (66)

4. Change to an improper fraction:

$2\frac{3}{4}$ $4\frac{1}{8}$ $5\frac{2}{3}$ $3\frac{2}{5}$ $7\frac{1}{6}$ (66)

5. Change these fractions so that they have the smallest common denominator:

$\frac{2}{3}$ $\frac{1}{2}$ $\frac{5}{9}$ $\frac{3}{4}$ $\frac{5}{6}$ (67)

6. Tell the missing numerators:

$5\frac{3}{2} = 6\frac{?}{2}$ $9\frac{7}{3} = 11\frac{?}{3}$ (68)

7. Subtract and check:

$9 - 3\frac{3}{4}$ $5\frac{1}{2} - 2\frac{5}{8}$ (69)

8. Multiply:

$4 \times 12\frac{1}{2}$ $\frac{3}{4} \times \frac{5}{6}$

$\frac{3}{4} \times \frac{5}{7}$ $\frac{2}{3} \times 12$ (75)

9. Multiply any way you prefer:

$6\frac{2}{3} \times 12$ $6\frac{2}{3} \times 11$

$3\frac{3}{4} \times \frac{8}{15}$ $2\frac{2}{3} \times 3\frac{3}{4}$ (76)

10. Divide:

$\frac{7}{8} \div \frac{3}{4}$ $\frac{5}{7} \div 1\frac{2}{3}$ (78)

Self-Help Test 2

1. Write this number with figures: two hundred million, six thousand, forty-two. (3–6)

2. Round off 6,743,246 to the nearest hundred thousand. (8)

3. Can you measure the length of a line accurately to the nearest sixteenth of an inch with a ruler graduated in eighths of an inch? (59) no

4. How much is $\frac{1}{2}$ of $\frac{3}{4}$? (75)

5. $\frac{1}{8}$ of a pound is what part of $\frac{3}{4}$ of a pound? (78)

6. If 9 oranges cost 48 cents, what is the cost of a dozen? (Hint: If $\frac{3}{4}$ of a number is 48, what is the number?) (82)

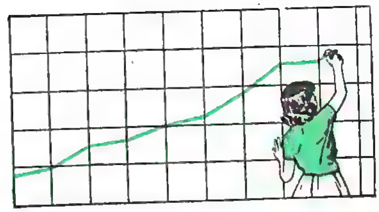
7. What is the difference between $7\frac{3}{10}$ and $4\frac{2}{5}$? (69)

8. How much will $5\frac{1}{4}$ yd. of cloth cost at $\$2\frac{1}{2}$ a yd.? (76)

9. How many $3\frac{3}{4}$-ft. pieces can be cut from a rope 15 ft. long? (78)

10. Find the difference between 5 and $1\frac{2}{3}$. (69)

Measuring your growth in arithmetic



Test 2a

1. Add $1\frac{5}{8}$, $2\frac{3}{4}$, and $5\frac{1}{3}$.

2. Subtract $2\frac{3}{4}$ from $5\frac{2}{3}$.

3. $3 \times \frac{2}{3} = \underline{\ ?\ }$ $\qquad 3\frac{3}{4} \times \frac{2}{3} = \underline{\ ?\ }$

4. $3 \div \frac{2}{3} = \underline{\ ?\ }$ $\qquad 5\frac{1}{8} \div 2\frac{1}{4} = \underline{\ ?\ }$

5. Dick keeps a record of the number of hours he works each day. How many hours has he worked from Monday through Friday when the record shows $1\frac{1}{2}$ hr., $2\frac{1}{4}$ hr., $1\frac{2}{3}$ hr., $2\frac{1}{2}$ hr., and $1\frac{3}{4}$ hr.?

6. Bill bought 5 pounds of plant food for bulbs he set out this spring. When he finished planting the bulbs, he had $1\frac{3}{4}$ pounds of plant food left. He had used ___?___ pounds.

7. If $\frac{1}{8}$ in. on a map represents 1 mile, $1\frac{1}{2}$ in. represents ___?___ miles.

8. $\frac{3}{8} + \frac{3}{16} = \underline{\ ?\ }$ $\qquad \frac{7}{10} - \frac{3}{5} = \underline{\ ?\ }$

9. $\frac{7}{8} = \frac{?}{16}$ $\qquad \frac{16}{24} = \frac{?}{3}$

10. $3\frac{3}{8} = \frac{?}{8}$ $\qquad 5\frac{2}{3} = 4\frac{?}{3}$

Test 2b

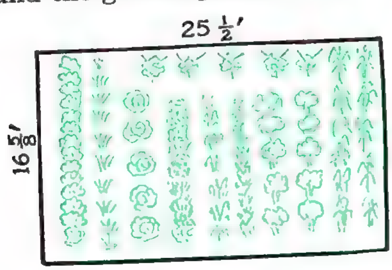
1. How much will $7\frac{5}{8}$ yd. of gingham cost at 64 cents a yard?

2. How many $\frac{1}{4}$-yd. lengths can you cut from a 5-yd. strip of gauze?

3. How many 3-in. lengths can you cut from $\frac{1}{4}$ yd.?

4. If $5\frac{7}{8}$ yd. of ribbon are sold from a roll of ribbon 10 yards long, there will be ___?___ yd. left.

5. What is the distance in feet around the garden pictured below?



6. At 28¢ a foot, how much would it cost to fence the garden in Ex. 5? You cannot buy a part of a foot.

7. If the denominator of $\frac{3}{4}$ is multiplied by 5, is the answer equal to $5 \times \frac{3}{4}$ or $\frac{3}{4} \div 5$?

8. Mrs. Lane bought 12 No. 2 cans of tomato juice and 12 No. $2\frac{1}{2}$ cans. A No. 2 can holds $2\frac{1}{2}$ cups and a No. $2\frac{1}{2}$ can holds $3\frac{1}{2}$ cups. The 24 cans contain ___?___ cups.

9. If a box of oranges holds $1\frac{3}{5}$ bushels and costs \$9.60, what is the cost per bushel?

10. If a train travels 713 miles in $15\frac{1}{2}$ hours, what is the average number of miles it travels in one hour?

Meaning of decimals

A fraction whose denominator is 10, 100, 1000, and so on, may be written as a *decimal fraction*. A decimal fraction is usually called a *decimal*.

- The fraction $\frac{3}{10}$ may be written as the decimal .3
- The fraction $\frac{3}{100}$ may be written as the decimal .03
- The mixed number $3\frac{4}{100}$ may be written as the decimal 3.04

- The *first* place to the right of the decimal point is *tenths*.

.1 is $\frac{1}{10}$ .6 is $\frac{6}{10}$
.9 is $\frac{9}{10}$ 2.6 is 2 *and* $\frac{6}{10}$

- The *second* place to the right of the decimal point is *hundredths*.

.01 is $\frac{1}{100}$ .08 is $\frac{8}{100}$
.25 is $\frac{25}{100}$ 7.06 is 7 *and* $\frac{6}{100}$

- The *third* place to the right of the decimal point is *thousandths*.

.001 is $\frac{1}{1000}$ .012 is $\frac{12}{1000}$
.125 is $\frac{125}{1000}$ 5.034 is 5 *and* $\frac{34}{1000}$

- The *fourth*, *fifth*, and *sixth* places to the right of the decimal point are, respectively, *ten thousandths*, *hundred thousandths*, and *millionths*.

.0004 is $\frac{4}{10,000}$ .000,34 is $\frac{34}{100,000}$
.000,007 is $\frac{7}{1,000,000}$

1. Each inch on the ruler (called an *engineer's scale*) at the bottom of the page is divided into ten equal parts. Each part is therefore .1 or $\frac{1}{?}$ of an inch.

2. Which is larger, $\frac{1}{8}$ inch or .1 inch? Explain.

3. Count from 1 to 3 by tenths. Point to the correct mark on the ruler as you count. Write the numbers across a sheet of paper, like this: 1, $1\frac{1}{10}$, $1\frac{2}{10}$, and so on.

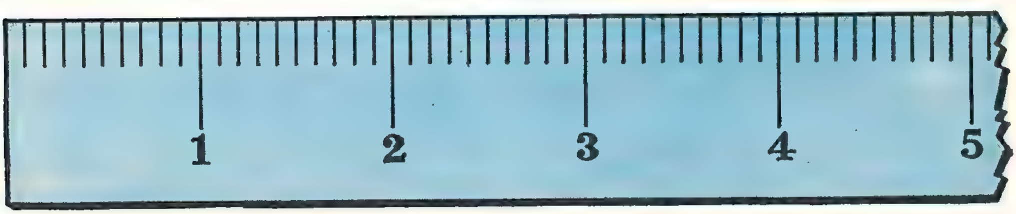
4. Underneath the numbers you have just written, write the same numbers as decimals, like this: 1.0, 1.1, 1.2, and so on. Point to the mark on the ruler for each number.

5. Counting by tenths, what are the next two numbers after .9?

6. Point to the 1-inch mark, the 1.0-inch mark, the $1\frac{1}{2}$-inch mark, and the 1.5-inch mark.

Explain why the $1\frac{1}{2}$-inch mark and the 1.5-inch mark are the same mark.

7. Is 2.7 ft. as much as 1 yard? On the blackboard draw a line 1 yard long. Divide it into feet. Show by estimate the 2.7-foot mark.



Meaning of decimals

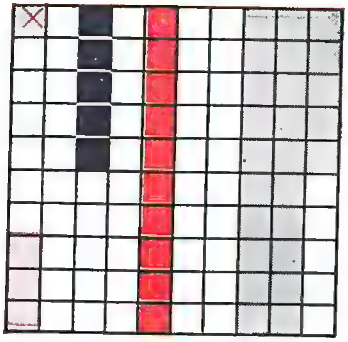


FIGURE 1

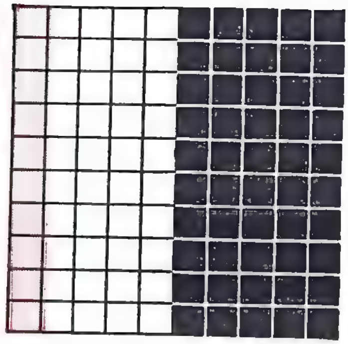


FIGURE 2

1. Figure 1 is divided into 100 equal parts. What part of the figure is marked ×? colored pink? black? red? gray?

2. Write your answers to Ex. 1 as common fractions; as decimals.

3. Count from $2\frac{70}{100}$ to $2\frac{80}{100}$ by hundredths and write the numbers in a horizontal line like this: $2\frac{70}{100}$, $2\frac{71}{100}$, and so on.

4. Underneath the numbers you have just written, write the same numbers as decimals, like this: 2.70, 2.71, and so on. When you have finished, read the numbers.

5. Beginning with the top square in the last column of Fig. 1, point to the squares in succession and count $\frac{91}{100}$, $\frac{92}{100}$, $\frac{93}{100}$, and so on. What should you say for $\frac{100}{100}$? Write the numbers from $\frac{91}{100}$ to $\frac{100}{100}$.

6. Write the numbers in Ex. 5, using decimals. What comes after .99?

7. Figure 2 is divided into _?_ equal parts.

- Jane says that 10 hundredths, or $\frac{10}{100}$, or .10 of the figure is colored pink.
- Peter says that 1 tenth, or $\frac{1}{10}$, or .1 of the figure is colored pink.

Show that both Jane and Peter are right.

8. Ex. 7 shows that $\frac{10}{100} = \frac{?}{10}$. Does .10 = .1?

9. _?_ hundredths of Figure 2 are colored black.

_?_ tenths of Figure 2 are colored black.

10. Ex. 9 shows that $\frac{50}{100} = \frac{?}{10}$. Does .50 = .5?

11. Is $\frac{1}{2}$ of Figure 2 colored black?

12. Does $\frac{50}{100} = \frac{5}{10} = \frac{1}{2}$? Does $.50 = .5 = \frac{1}{2}$?

13. Begin with .20 and count to .40 by 5 hundredths.

Comparing decimals

Copy and complete these statements. Replace the question marks by decimals.

1. $\frac{1}{2} = \frac{5}{10} = \underline{\ ?\ }$ $\frac{1}{2} = \frac{50}{100} = \underline{\ ?\ }$

2. $\frac{1}{4} = \frac{25}{100} = \underline{\ ?\ }$ $\frac{3}{4} = \frac{75}{100} = \underline{\ ?\ }$

3. Can you tell which is larger, .4 or .26?

▶ To see which of two common fractions, such as $\frac{2}{3}$ and $\frac{3}{4}$, is the larger, you change them to fractions with a common denominator.

$\frac{2}{3} = \frac{8}{12}$; $\frac{3}{4} = \frac{9}{12}$. So you know $\frac{3}{4}$ is larger than $\frac{2}{3}$.

▶ To see which of two decimal fractions, such as .4 and .26, is the larger, you also change them to decimals with a common denominator.

.4 = .40; .26 = .26. Since .40 is larger than .26, you know that .4 is $\underline{\ ?\ }$ than .26.

4. Which is larger, .8 or .76? .8 or .96? .8 or .75?

5. Arrange the three numbers in each group in order of size, writing the smallest number first in each case.

a)	3	.3	.03
b)	37	3.70	.37
c)	.39	.4	.04
d)	42	.42	4.02

6. What whole number is nearest to each of the following decimals?

3.98 15.01 16.25 4.76 5.22

7. Which of the following numbers are larger than $7\frac{1}{2}$?

7.4 7.6 7.72 7.49 7.12 7.89

8. Which number in each pair is larger?

2.6 or $2\frac{1}{2}$	1.9 or 2.0	2.32 or $2\frac{1}{2}$
.32 or 32	2 or 2.0	3.76 or $3\frac{3}{4}$

9. Which digit in 3.33 has the greatest value? the smallest value? Explain.

10. Select the smallest and largest numbers in each row:

.55	.52	.53	.5	.6
.68	.6	.70	.63	.59

11. Which of the following decimals have a value between .4 and .5?

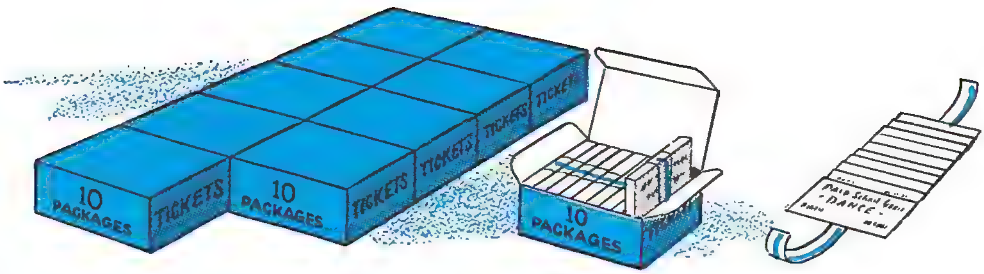
.67	.39	.43	.48	.69
.2	.53	.46	.56	.51

12. How much more is .50 than .05?

13. Each 7 in 77.7 is worth 10 times as much as the 7 to the $\underline{\ ?\ }$ of it. Each 7 is worth $\frac{1}{10}$ as much as the 7 to the $\underline{\ ?\ }$ of it. Explain.

14. Tom says his height is $62\frac{1}{2}$ inches. George says he is 62.7 inches tall. Which boy is taller?

15. The length of one line is 5.19 inches. The length of another line is $5\frac{1}{4}$ inches. Which line is longer? How much longer?



Meaning of thousandths

1. The students of Bradley School have tickets to sell for a Community Picnic.

- They have 10 boxes of tickets.
- In each box there are 10 packages of tickets.
- In each package there are 10 tickets.

How many tickets have they all together?

2. 1 ticket is $\frac{1}{1000}$ of all the tickets. Write $\frac{1}{1000}$ as a decimal.

3. One package contains 10 tickets, or $\frac{10}{1000}$ of all the tickets.

- $\frac{10}{1000} = \frac{1}{100}$
- Write $\frac{10}{1000}$ and $\frac{1}{100}$ as decimals.

4. .010 = .01 as shown in Ex. 3. Similarly .020 = _?_; and .030 = _?_.

5. One box contains 100 tickets, or $\frac{100}{1000}$ of all the tickets.

- $\frac{100}{1000} = \frac{10}{100} = \frac{1}{10}$
- Write $\frac{100}{1000}$, $\frac{10}{100}$, and $\frac{1}{10}$ as decimals.

6. .100 = .10 = .1 as shown in Ex. 5. Similarly .200 = _?_ = _?_; and .300 = _?_ = _?_.

7. Count by thousandths:

- from 1 thousandth to 10 thousandths
- from 25 thousandths to 35 thousandths
- from 138 thousandths to 142 thousandths

8. Write the numbers you said in Ex. 7 as common fractions; as decimals.

9. Copy the table below and write the missing numbers that correspond to the given numbers.

Fraction	$\frac{1}{1000}$	?	$\frac{100}{1000}$	$\frac{101}{1000}$	$\frac{110}{1000}$	$\frac{999}{1000}$
Decimal	.001	.009	?	?	?	?

10. The smallest 3-place decimal is _?_.

The largest 3-place decimal is _?_.

11. To make a whole you have to have _?_ thousandths.

12. Is a pint .005 of a quart, or .05 of a quart, or .5 of a quart? Explain.

Reading and writing decimals

When you read a decimal, think first of the number of places to the right of the decimal point. Then read the number and say after it the unit that goes with that number of places.

DECIMAL	NUMBER OF PLACES	HOW TO READ NUMBER
.324	Three	324 thousandths
.0324	Four	324 ten thousandths
.425,642	Six	425,642 millionths
.000,001	Six	1 millionth

1. In a number like .425,642 it is interesting to note the meaning of each digit. The analysis is shown in the box. Read each of the numbers and explain.

.4
.02
.005
.000,6
.000,04
.000,002
.425,642

2. Separate the following numbers as illustrated in the box and explain:

.5236   .0432   3.0054

3. When you read a mixed number (written as a decimal) such as 5.24, say *and* after you read the whole number; thus 5.24 is 5 *and* 24 _?_.

Read the following numbers:

	a	*b*	*c*	*d*
4.	.4	.04	.004	.0004
5.	3.2	.32	.032	.0032
6.	42.5	4.25	.425	.0425
7.	600.6	60.06	6.006	.6006

8. Explain these statements:

.026 means 26 thousandths.

.026 means .02 + .006

.026 means no tenths, 2 hundredths, 6 thousandths.

9. What does the zero mean in .06? in .046? in .406? in .740? in .107?

In writing decimals, it is often necessary to supply zeros. For example, to write $\frac{6}{100}$ as a decimal you must have the 6 in the *second*, or *hundredths*, place. To do this, you must write a zero in the *first*, or *tenths*, place. $\frac{6}{100} = .06$.

10. In writing $\frac{45}{1000}$ as a decimal, the 5 must be in the thousandths place and the 4 in the hundredths place. What will you write in the tenths place?

Write the following as decimals:

11. Six tenths

12. Six hundredths

13. Six thousandths

14. Two and two hundred two thousandths

15. Four and six tenths

16. Forty-six hundredths

17. Forty-six thousandths

18. Which is larger, 2 tenths or 87 thousandths? 67 hundredths or 7 tenths?

Adding and subtracting decimals

4.28
25.20
8.20
49.35
87.03

Decimals are added and subtracted just as whole numbers are added and subtracted.

In writing the numbers to be added or subtracted, you must be careful to keep the decimal points of all the numbers in a column, and to place the decimal point in the answer directly below the other decimal points.

This is done so you will add hundredths to hundredths, tenths to tenths, units to units, and so on.

Copy in columns, add, and check:

1. 246.27   239.09   275.25   245.39
2. 45.295   235.950   46.279   37.286
3. 29.34   39.25   35.30   56.00
4. $295.29 $246.39 $745.76

You know that numbers like 2 and 2.0 have the same value. Whenever necessary in addition or subtraction, supply zeros as is done in this sample: Subtract 4.35 from 6.2 ⟶

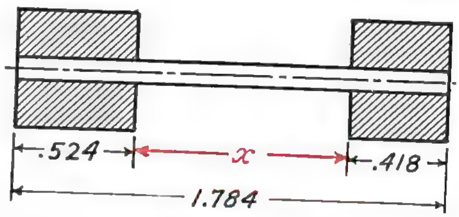
6.20
4.35
1.85

5. Add .3, .07, .16, 5.2
6. Subtract 2.08 from 7.65
7. Subtract 32.4 from 69
8. Subtract 6.60 from 17.08
9. Subtract .07 from 3.12

10. Find the perimeter of (distance around) a triangle with sides of 3.5 in., 4.3 in., and 5.0 in.

11. Find the perimeter of a rectangular piece of ground 26.5 rods wide and 35.6 rods long.

12. When the Meyers family started on a trip, the speedometer on their car registered 2975.8 mi. When they returned, it registered 3232.9 mi. How far did they travel on their trip?



13. Find the missing dimension x in the above figure.

14. The temperature on January 1 in Meadowvale was reported in the newspaper as 25.3° F. How many degrees below freezing was that?

15. One deep freezer has a storage space of 26 cubic feet. Another has 8.4 cubic feet of space. What is the difference in storage capacity?

Do these examples mentally:

16. $.3 + .03 =$ ___?___ $.3 - .03 =$ ___?___
17. $1 - .11 =$ ___?___ $1 + .11 =$ ___?___
18. $1.1 + .9 =$ ___?___ $1.1 - .9 =$ ___?___
19. $1.1 + .09 =$ ___?___ $1.1 - .09 =$ ___?___

Decimal point in a product by estimate

Decimals are multiplied just as whole numbers are multiplied. You must, however, *be careful about placing the decimal point.*

1. To multiply 3.14 by 6.3, think: 6.3 is a little more than 6. 3.14 is a little more than 3. So 6.3 × 3.14 should be a little more than 6 × 3, or 18.

$$\begin{array}{r} 3.14\\ 6.3\\ \hline 942\\ 1884\\ \hline 19782 \end{array}$$

(unfinished)

Study the example in the box and check the multiplication.

Then tell where to place the decimal point so that the answer will be a little more than 18.

2. 9.21 × 8.12 should be a little more than 9 × 8. Explain. Multiply the numbers as if they were whole numbers and then place the decimal point so that the answer is a little more than 72.

3. If you multiply 7.23 by 5.2, would the answer be nearest to 12, to 38, or to 376?

4. Multiply $6\frac{1}{2}$ by $5\frac{1}{4}$. Multiply 6.5 by 5.25. Place the decimal point by estimate.

Are your two answers equal? Explain.

Find the two products in each exercise and compare them:

5.	$7 \times 3\frac{1}{2}$	7×3.5
6.	$8 \times 2\frac{1}{4}$	8×2.25
7.	$11 \times 5\frac{1}{4}$	11×5.25

Choose the number that makes the answer to each statement sensible:

8. 3 × 2.6 = ___?___ (7.8 78 780)

9. 4 × 1.2 = ___?___ (480 4.8 48)

10. 6 × 3.2 = ___?___ (19.2 .192 1.92)

11. 7 × 2.6 = ___?___ (18.2 .182 1.82)

12. 7.2 × 6 = ___?___ (4.32 .432 43.2)

13. 4 × .63 = ___?___ (2.52 25.2 .252)

14. .3 × .4 = ___?___ (12 1.2 .12)

15. .6 × .2 = ___?___ (1.2 .12 12)

16. .2 × .5 = ___?___ (1.0 .10 10)

The digits in each of the following products are correct, but the decimal point has been omitted and some of the products have been rounded off. Tell by estimate where the decimal point should be placed.

	a	*b*	*c*
17.	3 × 6.2 = 186	4.2 × 5.3 = 2226	6 × 3.17 = 190
18.	9 × 5.7 = 513	3.6 × 7.4 = 266	12.9 × 5.6 = 7224
19.	532.7 × 2.4 = 1278	4.32 × 3.7 = 15984	4.62 × 2.73 = 1261
20.	4.2 × 3.273 = 137466	4.3 × 7.2 = 3096	10.1 × 4.83 = 488

Placing the decimal point in a product

1. Multiply and place the decimal point by estimate:

8.3 4	9 3.4	5 1 2	1.1 3 2
5.8	7.5	3.6	1 4

2. In the multiplication 5.8 × 8.34 (Ex. 1), there are two decimal places in the multiplicand and ? decimal place in the multiplier. In the product there are ? decimal places.

3. In the multiplication 7.5 × 93.4 (Ex. 1), there is ? decimal place in the multiplicand and ? decimal place in the multiplier. There are ? decimal places in the product.

4. Make statements similar to those in Exs. 2 and 3 for the remaining multiplications in Ex. 1.

5. Make a rule for placing the decimal point in a product. Then compare your rule with this one:

> **The number of decimal places in the product is the sum of the number of decimal places in the multiplier and in the multiplicand.**

First estimate the products in Exs. 6–9, and then do the multiplications:

6.	52×6.3	4.6×3.8	.046×5000
7.	.125×8	450×.6	3.92×26.2
8.	.013×4.6	.72×95	256.7×2.5
9.	35.8×2.7	.95×276	24.58×.07

10. Don wanted to find .3 × .02. He wondered whether the product was .6, .06, .006, or .0006.

So he changed the decimals to common fractions and wrote:

$$\frac{3}{10} \times \frac{2}{100} = \frac{6}{1000}$$

Then he knew that the product, written as a decimal, was ?.

11. To find .4 × .002, Don wrote:

$$\frac{4}{10} \times \frac{2}{1000} = \frac{8}{10{,}000}$$

Then he knew that the product, written as a decimal, was ?.

12. Show that Don's answers in Exs. 10 and 11 agree with the rule below Ex. 5.

Ex. 10

$$\boxed{\begin{array}{r} .0\,2 \\ \times\ .3 \\ \hline ? \end{array}}$$

Ex. 11

$$\boxed{\begin{array}{r} .0\,0\,2 \\ \times\ .4 \\ \hline ? \end{array}}$$

13. Is the product of .2 × .03 equal to .006 or .600 or .060?

14. Is .3 × .06 equal to .180 or .018? How do you decide where to write the zero?

15. Multiply:

.0 6	.0 6	1.5	.1	.1 1
.3	.0 6	.0 5	.1	.0 1

16. Find the cost of a gross of pencils at $.045 each. (How do you read $.045?)

Practice in multiplying decimals

Do these multiplications. Estimate the answer in each case to see if the product you obtained by multiplying is sensible.

	a	*b*	*c*	*d*
1.	3.6×4.7	3.79×4.68	$.07 \times 4831$	$.75 \times .03$
2.	22.7×92	8.73×2.05	46.9×86.3	$.632 \times .25$
3.	$.25 \times .27$	$59.63 \times .09$	47.28×20.05	$.0007 \times .03$
4.	$839.4 \times .8$	$9.7 \times .01$	27.09×240.6	38.7×45.6
5.	5.21×8.5	$.003 \times 27$	$.254 \times 876$	$.005 \times 14$
6.	$1.5 \times .003$	$.84 \times 269$	$3.07 \times .74$	256.7×24.5

7. Milk is sometimes sold by weight. One gallon of milk weighs about 8.6 pounds. How many pounds of milk will fill a 25-gallon can?

8. A certain jet plane was reported as traveling 10.8 miles a minute. That is _?_ miles an hour.

9. George walks 15 blocks to school. If a block has an average length of .1 mile, how far does George walk to school?

10. The distance a ship travels is measured in *nautical miles.* A nautical mile is about 1.15 times as long as a land mile.

The *Queen Elizabeth* can travel 31 nautical miles an hour. This is a speed of _?_ land miles per hour.

11. If traveling by bus costs $.023 a mile, how much will Mae have to pay for a 76-mile bus ride?

12. Mr. Grant has found that on the average he drives 19.9 miles on each gallon of gasoline. At that rate how far can he go on 4 gallons?

13. John Stone flew with his father from their home town in Texas to Mexico City. The airline distance of their trip was listed as 1100 *kilometers* (kil′-o-me-ters). One kilometer is about .62 mile, so the airline distance is about _?_ miles.

14. Mr. Bell finds that the average cost of running the small motor that pumps water on his farm is 1.4 cents an hour. In a month when the motor runs 118 hours, the cost will amount to $_?_. .014

15. The distance around a wheel can be found by multiplying the length of a spoke by 6.28. If a spoke is 3.15 ft. long, what is the distance around the wheel?

Discovering rules for multiplying

1. If you move the decimal point in .24

- 1 place to the right, you have 2.4
- 2 places to the right, you have 24
- 3 places to the right, you have 240

What number do you get when you move the decimal point in 2.03 one place to the right? two places? three places?

2. George did these multiplications to see if he could discover how the decimal point moves when a number is multiplied by 10. Can you tell?

$10 \times 3.8 = 38.$	$10 \times .025 = .25$
$10 \times 2.36 = 23.6$	$10 \times .001 = .01$
$10 \times 4 = 40$	$10 \times .4 = 4$

3. To multiply a number by 10, move the decimal point __?__ place to the __?__. Supply a zero if necessary.

4. What rule can you discover from these multiplications?

$100 \times .024 = 2.4$	$100 \times 45.6 = 4560$
$100 \times .001 = .1$	$100 \times 4. = 400$

5. To multiply by 100, move the decimal point __?__ places to the __?__. Supply zeros if necessary.

6. Multiplying a number by 1000 moves the decimal point __?__ places to the __?__.

$1000 \times .036 =$ __?__
$1000 \times 1.15 =$ __?__
$1000 \times 43.7 =$ __?__

7. Multiply the following numbers by 10; by 100; by 1000.

3.6   4.92   .73   5.631   7.0   42.

There are two mistakes in Exs. 8–11. Can you find them?

	a	*b*	*c*
8.	$10 \times 32. = 320.$	$100 \times 32 = 3200.$	$1000 \times 32 = 32{,}000$
9.	$10 \times 3.2 = 32$	$100 \times 3.2 = 320.$	$1000 \times 3.2 = 3200$
10.	$10 \times .32 = 3.2$	$100 \times .32 = 3.2$	$1000 \times .32 = 320$
11.	$10 \times .432 = 4.32$	$100 \times .432 = 43.2$	$1000 \times .432 = 43.2$

Which is larger?

12.	10×3, or 32	10×5.87, or 587	10×7.562, or 76
13.	100×5.2, or 500	100×59.8, or 598	100×38, or 390
14.	1000×6.74, or 674	$1000 \times .7$, or 7100	1000×5.4, or 550

Multiplying by 10, by 100, by 1000

1. The girls in the Garden Club are buying 100 bulbs to plant along the school walls. What will the bulbs cost at $.023 a bulb?

They can get a second hundred bulbs at $.018 a bulb. What will the second hundred bulbs cost?

2. What is the cost of 1000 sheets of fine tracing paper at $.05 a sheet?

The boys' Model Plane Club uses this tracing paper for making drawings of planes. The club spends _?_ for every 10 sheets it uses.

3. The guide at the broadcasting studio told John that the master electronic clock used by the broadcasting company varied from the correct time by less than .001 second a day.

John said, "Without being corrected, the clock could run _?_ days before it would be 1 second off."

4. Mary Jane's brother Harold works in a manufacturing plant and is paid at the rate of $1.185 an hour. What is he paid for 100 hours of work?

5. Doris saw this notice in the paper: "Fly the safe way at only 5.5 cents a mile." If Doris flew to her grandmother's home approximately 1000 miles away, how much would it cost her?

6. Joe's father told him that the bus line charged $.0185 a mile. What does Joe have to pay for a 100-mile trip on this line?

7. Frank has found that his profit on each dozen eggs he sells in the city is $.162. What is his profit on 100 dozen eggs?

8. At $21.70 a ton, what is the cost of 10 tons of coal?

Dividing a decimal by a whole number

1. Does $\frac{1}{3}$ of 27.5 equal a little more than 9? How do you know?

2. Does $\frac{1}{4}$ of 59.5 equal about 15 or about 150? Why?

3. Are these answers sensible?

$\begin{array}{r}6.4\\2\overline{)12.8}\end{array}$ $\qquad$ $\begin{array}{r}3.2\\31\overline{)99.2}\end{array}$ $\qquad$ $\begin{array}{r}24.46\\8\overline{)195.68}\end{array}$

4. Use Ex. 3 to help you make a rule about placing the decimal point in the quotient when you divide a decimal by a whole number.

5. The speedometer on Mrs. Coe's car showed that she had driven 296.1 miles in a 7-day period. How many miles per day was that on the average?

In order to find out, you must divide _?_ by _?_.

▶ Place the decimal point in the quotient directly above the decimal point in the dividend.

$$\begin{array}{r}.\\7\overline{)296.1}\end{array}$$

▶ Divide as you do with whole numbers.

$$\begin{array}{r}42.3\\7\overline{)296.1}\end{array}$$

▶ Check by estimating. The answer must be near to but more than 40 miles because $7 \times 40 = 280$.

▶ Check by multiplication.

$$\boxed{7 \times 42.3 = 296.1}$$

To divide a decimal by a whole number, place the decimal point in the quotient right above the decimal point in the dividend. Divide as you do with whole numbers.

Copy Exs. 6–8 and place the decimal point correctly in each quotient. Then read the quotients. Check each answer by estimating and also by multiplying.

	a	*b*	*c*
6.	$\begin{array}{r}4\,2\\8\overline{)3\,3.6}\end{array}$	$\begin{array}{r}6\,8\,3\\6\overline{)4\,0.9\,8}\end{array}$	$\begin{array}{r}4\,0\,6\\5\overline{)2\,0.3\,0}\end{array}$
7.	$\begin{array}{r}3\,0\\3\,9\overline{)1\,1.7\,0}\end{array}$	$\begin{array}{r}7\,3\\9\overline{)6\,5.7}\end{array}$	$\begin{array}{r}1\,0\,6\\5\,2\overline{)5\,5.1\,2}\end{array}$
8.	$\begin{array}{r}3\,4\\6\,7\overline{)2\,2.7\,8}\end{array}$	$\begin{array}{r}1\,5\,1\\7\overline{)1.0\,5\,7}\end{array}$	$\begin{array}{r}0\,4\,1\\9\overline{).3\,6\,9}\end{array}$

Copy and divide. Check your answers by estimating; by multiplying.

9.	$5\overline{)125.5}$	$4\overline{)143.2}$	$8\overline{)34.56}$
10.	$6\overline{)27.12}$	$5\overline{)193.20}$	$23\overline{)46.69}$
11.	$8\overline{)32.16}$	$49\overline{)17.64}$	$32\overline{)20.80}$
12.	$6\overline{)1.56}$	$83\overline{)19.505}$	$6\overline{)24.738}$
13.	$9\overline{)540.81}$	$41\overline{)832.3}$	$19\overline{)59.66}$
14.	$7\overline{)21.7}$	$54\overline{)194.4}$	$9\overline{)27.09}$
15.	$6\overline{)15.6}$	$27\overline{)20.25}$	$6\overline{).156}$
16.	$8\overline{)40.8}$	$8\overline{)4.08}$	$8\overline{).408}$
17.	$9\overline{)721.8}$	$9\overline{)72.18}$	$9\overline{)7.218}$

18. Knitting needles can be bought for 35 cents a pair. The girls in the Knitting Club were able to get 18 pairs of the same kind for $5.40.

Each girl had to pay _?_ cents less than the usual price.

Getting ready to divide by decimals

1. To do the division $2\frac{1}{2}\overline{)12}$:

Jane wrote: $12 \div 2\frac{1}{2} = 12 \div \frac{5}{2} = 12 \times \frac{2}{5} = 4\frac{4}{5}$

Tom wrote: $\frac{12}{2\frac{1}{2}} = \frac{2 \times 12}{2 \times 2\frac{1}{2}} = \frac{24}{5} = 4\frac{4}{5}$

Joe wrote: $2\frac{1}{2}\overline{)12} = 5\overline{)24} = 4\frac{4}{5}$

- Whose solution is clearest to you? shortest? longest?
- Who changed the divisor $2\frac{1}{2}$ to a whole number?
- Who multiplied both the divisor (denominator) and the dividend (numerator) by 2?
- Why did Tom and Joe multiply by 2 rather than by 3, or 5, or 27?

2. Write the solutions of these divisions the way you think each student in Ex. 1 would write them:

$3\frac{7}{10}\overline{)21}$ $\quad 2\frac{1}{10}\overline{)17}$ $\quad 3\frac{3}{10}\overline{)75}$

3. To find how many 7.5-foot lengths of fencing are needed for a fence 30 ft. long:

Jane wrote: $30 \div 7.5 = 30 \div 7\frac{1}{2} = 30 \div \frac{15}{2} = 30 \times \frac{2}{15} = \frac{60}{15} = 4$

Tom wrote: $\frac{30}{7.5} = \frac{10 \times 30}{10 \times 7.5} = \frac{300}{75} = 4$

Joe wrote: $7.5\overline{)30} = 75\overline{)300} = 4$

- Who changed the divisor 7.5 to a whole number?
- Who multiplied both the divisor (denominator) and the dividend (numerator) by 10?

4. Which of these three solutions of $1.2\overline{)13.2}$ do you prefer?

- $\frac{13.2}{1.2} = 13\frac{2}{10} \div 1\frac{2}{10} = \frac{132}{10} \div \frac{12}{10} = \frac{\cancelto{11}{132}}{\cancelto{1}{10}} \times \frac{\cancelto{1}{10}}{\cancelto{1}{12}} = 11$
- $\frac{13.2}{1.2} = \frac{10 \times 13.2}{10 \times 1.2} = \frac{132}{12} = 11$
- $1.2\overline{)13.2} = 12\overline{)132} = 11$

5. Write the solution of $1.4\overline{)2.24}$ in the three ways shown in Ex. 4.

By what would you multiply the divisor and the dividend of each of these to make the divisor a whole number?

6.	$3\frac{1}{2}\overline{)8}$	$2\frac{1}{3}\overline{)12}$	$2\frac{1}{4}\overline{)17}$
7.	$2\frac{1}{10}\overline{)13}$	$3\frac{7}{10}\overline{)29}$	$3\frac{1}{5}\overline{)14}$
8.	$3.1\overline{)16}$	$2.7\overline{)41}$	$3.05\overline{)121}$

9. Do the divisions in Exs. 6–8.

10. Explain each step in finding $.35\overline{).315}$:

▶ $.35\overline{).315} = \frac{.315}{.35}$

▶ $\frac{100 \times .315}{100 \times .35} = \frac{31.5}{35}$

To make the divisor .35 into a whole number you multiply the .35 by _?_. Then what do you do to the .315?

▶ $\overset{.?}{35\overline{)31.5}}$ (Check by multiplying.)

11. Why are the following true?

$6.1\overline{)19.5} = 61\overline{)195}$ $\quad .61\overline{).195} = 61\overline{)19.5}$

$.061\overline{).195} = 61\overline{)195}$ $\quad 6.1\overline{)1.95} = 61\overline{)19.5}$

Dividing by a decimal

1. Can you divide 10.324 by .29? If you need help study the steps below.

▶ Change the divisor .29 to a whole number by multiplying by 100.

```
.2 9‸)1 0.3 2‸4
```

That moves the decimal point two places to the right. Make a caret at the new position of the decimal point.

▶ Then you must also multiply the dividend 10.324 by 100. That moves the decimal point 2 places to the right. Place a caret to show the new position of the decimal point.

▶ Put a decimal point in the quotient directly above the caret in the dividend.

```
               .
.2 9‸)1 0.3 2‸4
```

▶ Explain how the division is finished. Is the answer reasonable? Does it check? Does 35.6 × .29 = 10.324?

```
           3 5.6
.2 9‸)1 0.3 2‸4
          8 7
          1 6 2
          1 4 5
            1 7 4
            1 7 4
```

2. To divide 60 by 7.5:

▶ Make the divisor a whole number.

▶ Move the decimal point in the dividend the *same* number of places to the right. Annex a zero to do it.

▶ Put the decimal point in the quotient.

▶ Divide and check.

```
           8.
7.5‸)6 0.0‸
      6 0 0
```

Here are the rules for dividing by a decimal:

Move the decimal point to the right of the divisor.

By this first move you make the divisor a whole number by multiplying by 10 or by 100 or by 1000.

Move the decimal point in the dividend as many places to the right as you moved it in the divisor, supplying zeros when necessary.

By this second move you multiply the dividend by 10 or by 100 or by 1000, just as you did with the divisor.

Divide as with a whole number, placing the decimal point in the quotient directly above the new position of the decimal point in the dividend.

Divide and check:

3.	.6)24	7.2)288
4.	2.31)14.091	2.4)614.4
5.	.315).11340	.8)4320
6.	.18)129.6	3.7)8.88
7.	.214).6848	2.4)73.20
8.	.75)10.50	1.5)75.15
9.	.29)10.324	.12).48
10.	2.3)69	.205)123

11. It is sometimes necessary to put zeros in the quotient, as in the four examples below.

Study the divisions. Check to see if each answer is sensible.

a) $\begin{array}{r} .0\,2 \\ 3\overline{).0\,6} \end{array}$ *b*) $\begin{array}{r} .0\,2 \\ .3_{\wedge}\overline{).0_{\wedge}0\,6} \end{array}$

c) $\begin{array}{r} .0\,0\,2 \\ 3\overline{).0\,0\,6} \end{array}$ *d*) $\begin{array}{r} .0\,0\,3 \\ 32\overline{).0\,9\,6} \end{array}$

Divide and check:

12. $2\overline{).02}$ $1.6\overline{).048}$ $1.2\overline{).0036}$

13. $15\overline{).45}$ $16\overline{).48}$ $4.2\overline{).210}$

14. The Youngs spent $112.20 for food during the month of November. What was the daily average cost for food?

15. A fast train made a run of 79.2 miles in 66 minutes. What was its average speed in miles per minute?

16. Herbert wants to get a sweater that costs $9.75. If he saves $.75 a week, how long will it take him to save enough to buy the sweater?

17. John's father works on a machine that cuts metal rods into pieces .6 inch long. How many pieces does the machine cut from a rod 12 ft. long?

18. At $.78 a dozen how many whole dozens of eggs can be bought for $5.00?

19. A stratocruiser made a nonstop flight of 3500 miles. Its time was reported as 9.8 hours. Find its average speed in miles per hour.

20. A prize cow produced 13,937 pounds of milk one year. If one quart of milk weighs 2.2 pounds, this cow produced _?_ quarts of milk that year.

21. If an airliner uses on an average 1 gallon of gasoline every 2.5 miles, how many gallons is it likely to use on a flight of 2330 miles?

Supply the missing information:

22. When I divide 67.2 by .32, I first change the divisor to 32 and the dividend to _?_ by multiplying each by _?_.

23. When I divide 6.72 by .32, I first change the divisor to _?_ and the dividend to _?_ by multiplying each by _?_.

24. When I divide 6.72 by 3.2, I first change the divisor to _?_ and the dividend to _?_ by multiplying each by _?_.

25. When I divide 67.2 by .032, I first change the divisor to _?_ and the dividend to _?_ by multiplying each by _?_.

26. Do the divisions in Exs. 22–25.

27. $.98\overline{)198.94}$ $.60\overline{)6.6}$

28. $.07\overline{)5.684}$ $.48\overline{)1.1808}$

29. $.6\overline{)12.18}$ $.007\overline{)35}$

30. $.1\overline{).001}$ $.1\overline{).0101}$

31. $4.3\overline{).172}$ $26\overline{).052}$

Discovering rules for dividing

1. If you move the decimal point in 24.3

- 1 place to the left you have 2.43;
- 2 places to the left you have .243;
- 3 places to the left you have .0243.

What number do you get when you move the decimal point in 25.36 one place to the left? 2 places? 3 places?

2. If you know that 10×15 is 150, you know that $10\overline{)150}$, or $\frac{150}{10}$, is ___?___.

3. If you know that 10×2.43 is 24.3, you know that $10\overline{)24.3}$ is ___?___.

4. If 100×1.728 is 172.8, then $100\overline{)172.8}$ is ___?___.

5. George did these divisions to see if he could discover how the decimal point moves when a number is divided by 10. Can you tell?

$150 \div 10 = 15.0$	$243 \div 10 = 24.3$
$72.8 \div 10 = 7.28$	$23.6 \div 10 = 2.36$
$.25 \div 10 = .025$	$3.62 \div 10 = .362$

In each case he saw that the decimal point is moved ___?___ place to the left.

6. To divide a number by 10, move the decimal point ___?___ place to the left. Supply a zero when necessary.

7. What rule concerning division by 100 can you discover from these divisions?

$2.4 \div 100 = .024$	$56 \div 100 = .56$
$.1 \div 100 = .001$	$400 \div 100 = 4$

8. To divide a number by 100, move the decimal point ___?___ places to the ___?___. Supply zeros when necessary.

9. To divide a number by 1000, move the decimal point ___?___ places to the left. Supply zeros when necessary.

$437 \div 1000 =$ ___?___	$1.15 \div 1000 =$ ___?___
$.036 \div 1000 =$ ___?___	$62.7 \div 1000 =$ ___?___

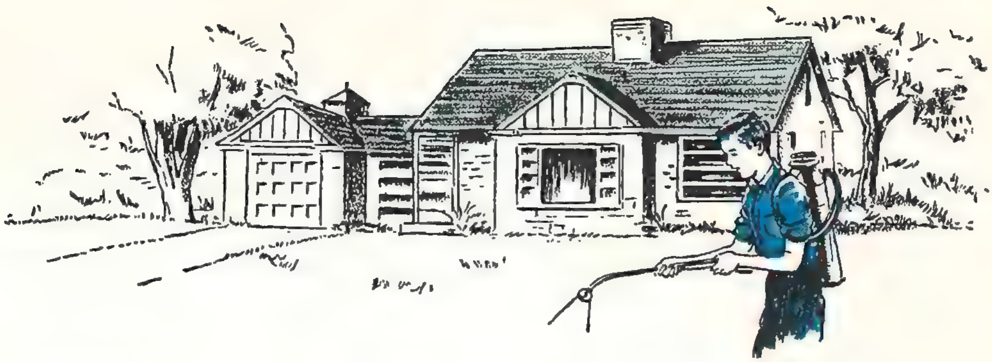
10. Do you see that, when you divide a number by 10, by 100, or by 1000, you move the decimal point as many places as there are zeros in the divisor? How many places would you move the decimal point to divide by 1,000,000?

11. Can you find any mistakes in these exercises?

$32 \div 100 = .32$	$3.2 \div 10 = .32$
$3200 \div 1000 = 3.2$	$320 \div 100 = 3.2$
$3200 \div 100 = 32$	$320 \div 10 = 32$
$.432 \div 1000 = 432$	$43.2 \div 1000 = .0432$

Divide each of the following numbers by 10; by 100; by 1000:

	a	*b*	*c*	*d*
12.	285	38	5	2643
13.	37	5.4	.294	62.5
14.	59	27.9	.03	6.54
15.	1.6	7.42	.2	4.02
16.	21	1.11	1.2	273



Dividing by 10, by 100, by 1000

1. Earl paid \$1.25 a can for weed killer. The directions said that the can contained enough weed killer for 1000 square feet of ground.

Is the cost of the weed killer per square foot of ground $12\frac{1}{2}$¢, $1\frac{1}{4}$¢, or a little more than a tenth of a cent?

2. One 2.5-pound can of D.D.T. contains enough for 1000 square feet of lawn. At this rate, __?__ pound is used for each square foot of lawn.

3. Strawberry plants are advertised at 100 plants for \$9.95. At that rate, what does one plant cost?

4. Ida bought a 100-pound bag of rose food for \$8.50. She could have bought a 10-pound box for \$1.35. How much did she save per pound by buying the 100-pound bag?

5. Grass seed is advertised at \$100.00 for 100 pounds or \$10.50 for 10 pounds. What is the cost per pound at each rate?

6. Harold bought 1000 feet of spruce boards for \$110. What did he pay per foot for the boards?

7. The directions for sowing one kind of grass seed are: "1 pound for 1000 square feet." How many pounds are needed for a lawn that contains 5000 sq. ft.? for a lawn that contains 1200 sq. ft.?

8. Roofing boards were reduced from \$95.00 per thousand feet to \$85.00 per thousand. If Bill bought boards at the reduced price, how much did he save per foot of board?

9. Laura's uncle harvested 2029 bushels of corn from 10 acres of his farm. What was the average number of bushels per acre?

10. John can buy a 10-lb. bag of grass seed for \$4.25. At that rate, what would the seed cost him per pound?

11. If 1000 children in Fairview gave \$275 to the Red Cross, what was the average gift per child?

12. The Glenacre Girl Cyclists bought 100 pounds of candy for their annual sale. If they paid \$38.50 for the candy, what did it cost per pound?

Practice in division of decimals

Look at the example at the right. 28 ÷ 2.5 = __?__.

Note the zeros annexed to the dividend in order to complete the division.

```
        1 1.2
2.5∧)2 8.0∧0
     2 5
       3 0
       2 5
         5 0
         5 0
```

Complete the following divisions. Annex zeros to the dividend when needed.

	a	*b*	*c*
1.	9)33.39	5)1.395	8).1208
2.	9).2187	7)398.3	3)452.4
3.	8).0568	5).021	.7)2107
4.	.8)14.64	.8).02	.7).0567
5.	5.6)448	32)200	1.8)4.5
6.	2.5)10	5.4)810	2.8)17.5

Divide as indicated:

	a	*b*
7.	3.4)7.82	3.4)78.2
8.	3.4)782	.34)7.82
9.	.34)78.2	.034)782
10.	6.3)190.26	.63)1902.6
11.	.063)19026	.06).318
12.	.06).318	.6).0318
13.	.007)2.205	.07)22.05
14.	.7)220.5	7.2)2162.88
15.	.72)2162.88	.072)21.6288
16.	26)8.32	.26)8.32
17.	.2).0204	.2)2.04
18.	42)13.44	42).1344

Just for fun

Tell where the decimal point should be placed in each of these statements:

1. The length of your fingernail might be 72 in.

2. A person's normal temperature is 986 degrees Fahrenheit.

3. Bill rode his bicycle 98 miles in $1\frac{1}{2}$ hours.

4. A plane traveled 600 miles in 275 hours.

5. The average weight of 12 seventh-grade boys is 925 pounds.

6. A piece of ordinary typewriter paper is 85 in. by 11 in.

7. Tom held his breath for 12 min.

8. Joe said he was 625 inches tall.

9. The average yearly growth for 10-year olds is 191 inches.

Oral review of decimals

Tell the next three numbers in each series:

	a			b		
1.	.6	.7	.8	.06	.07	.08
2.	.96	.97	.98	1.6	1.7	1.8
3.	.006	.007	.008	.026	.027	.028
4.	.096	.097	.098	.116	.117	.118
5.	.136	.137	.138	.996	.997	.998

6. Read the following:

3.6   3.06   3.62   3.006   3.625

7. Is 3.4 between 3 and 4 or between 33 and 34?

8. Between what two whole numbers is each of the following?

3.2   4.56   6.007   9.999   27.6

9. How much more is 3.7 than $3\frac{1}{2}$?

10. Is 6.0 equal to, greater than, or less than 6?

11. Which one in each pair is larger?

3 or .7   .6 or $\frac{1}{2}$ $\frac{3}{4}$ or .73   .07 or .7

12. Tell the missing numbers:

7.96   7.97   7.98   ___?___   ___?___   ___?___

13. How much less than a yard is 2.4 feet?

14. Is .06 less than, equal to, or greater than .6?

15. Tell the missing numbers:

.996   .997   .998   ___?___   ___?___   ___?___

16. Multiply these numbers by 10; by 100; by 1000:

2.4   3.76   .52   2.468   6.0   24

17. Divide each number in Ex. 16 by 10; by 100; by 1000.

18. By estimating the product choose the number that is most nearly correct for 3.12×5.16:

1.6099   16.099   160.99   1609.9

19. Which of the following have the same value?

$4.7\overline{)9.23}$ $47\overline{)92.3}$ $47\overline{)9.23}$ $\frac{9.23}{4.7}$ $\frac{92.3}{47}$

20. Change these decimals to common fractions reduced to lowest terms:

.3   .5   .03   .05   .10
.20   .25   .43   .50   .125

21. From 3.6 to 4.2 is ___?___ tenths.

22. From .99 to 1.01 is ___?___ hundredths.

23. From 3.007 to 3.010 is ___?___ thousandths.

	a	b	c
24.	$.2 \times .2$	$.2 \times .02$	$.02 \times .02$
25.	$.2 + .2$	$.2 + .02$	$.02 + .02$
26.	$.2 \div .2$	$.2 \div .02$	$.02 \div .02$

27. What decimal is halfway between:

.3 and .4?   .30 and .40?
.35 and .45?   .40 and .41?

Rounding off decimals

1. George Baker saw in a headline:

JET GOES 523.7 M.P.H.

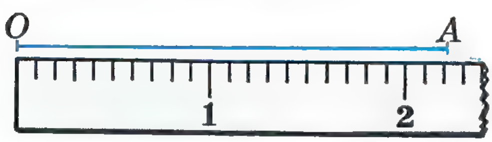
But in the news item that followed, he read that the plane averaged 523.736 miles per hour.

George's father said that in the headline the speed was rounded off to the *nearest tenth* of a mile per hour.

Do you know what the speed would be if it were rounded off to the *nearest hundredth* of a mile per hour?

2. Line AB is more than $1\frac{1}{2}''$ long. It is less than $1\frac{3}{4}''$ long. Is it nearer $1\frac{1}{2}''$ or $1\frac{3}{4}''$?

Point B is not opposite the $1\frac{3}{4}''$ mark, but line AB is $1\frac{3}{4}''$ long *to the nearest quarter of an inch.*



3. Line OA is more than 2.2″ long and less than 2.3″ long. Is it nearer 2.2″ or 2.3″?

Line OA is 2.2″ long *to the nearest tenth of an inch.*

4. 3.78″ to the nearest tenth of an inch is __?__.

5. 4.83 rounded off to the nearest tenth is __?__.

6. Can you make a rule for rounding off a decimal to the nearest tenth?

Here is the rule for rounding off a decimal to the nearest tenth:

> **If the digit in hundredths place is 5 or more, increase the digit in tenths place by 1 and drop all digits to the right of tenths place.**
>
> **If the digit in hundredths place is less than 5, simply drop all digits to the right of tenths place.**

7. To give 62.76 to the nearest tenth round it off to __?__.

To give 62.74 to the nearest tenth round it off to __?__.

8. Make a rule for rounding off a decimal to the nearest hundredth; to the nearest thousandth. Illustrate your rules.

9. Round off the following decimals to the nearest tenth:

43.41	43.47	43.49	63.02	63.07
57.28	57.23	57.25	8.436	8.430

10. Round off the following decimals to the nearest hundredth:

43.412	43.418	63.002	63.007
5.7283	5.7239	84.364	84.305

11. Round off the following decimals to the nearest thousandth:

43.4127 43.4184 63.0022

Quotients to the nearest tenth or hundredth

Some divisions have remainders even though the quotients are carried to many decimal places.

In such cases, it is common practice to express (give) the quotients *to the nearest tenth* or *to the nearest hundredth.*

1. Divide 422 by 23 and give the quotient to the nearest tenth.

$$\begin{array}{r} 18.34 \\ 23\overline{)422.00} \\ \underline{23} \\ 192 \\ \underline{184} \\ 8\,0 \\ \underline{6\,9} \\ 1\,1\,0 \\ \underline{9\,2} \end{array}$$

▶ Carry the division to hundredths as shown, and then round off the answer to tenths.

▶ 18.34 to the nearest tenth is _?_.

▶ $422 \div 23 = 18.3$ *to the nearest tenth.*

2. Make a rule for finding a quotient to the nearest tenth; to the nearest hundredth. Illustrate your rules.

To express a quotient to the nearest tenth, first find the quotient expressed to hundredths and then round it off to tenths.

To express a quotient to the nearest hundredth, first find the quotient expressed to thousandths and then round it off to hundredths.

Divide. Express the quotients to the nearest tenth.

	a	*b*	*c*
3.	$7\overline{)642}$	$6\overline{)745}$	$17\overline{)1024}$
4.	$2.3\overline{)1465}$	$73\overline{)9642}$	$19\overline{)625}$
5.	$37\overline{)10.674}$	$123\overline{)973}$	$267\overline{)4671.2}$

6. Express the quotients in Ex. 5 to the nearest hundredth.

7. A plane climbed 26,000 feet in 19.4 minutes. What was its average rate of climb in feet per minute? Give the answer to the nearest tenth.

8. A better grade of gasoline was later used in the plane in Ex. 7 and the plane then climbed 26,000 feet in 12.2 minutes.

What was the average rate of climb in feet per minute? Give the answer to the nearest tenth.

9. In order to pay a bill of $29.27, the Boys Club voted to assess each of its 12 members equally.

How much would each member have to pay to the nearest cent (nearest hundredth of a dollar)?

10. In a series of tests a new Diesel engine was found to use one gallon of fuel every 16 minutes.

How large a fuel tank would be needed to keep the engine running steadily for 3 hours? Give your answer to the nearest tenth of a gallon.

Finding an average

1. Fred spent 20¢ for his lunch on Monday, 23¢ on Tuesday, 30¢ on Wednesday, 27¢ on Thursday, and 20¢ on Friday.

- The total amount spent for lunches was ___?___ cents.
- He would have spent the same total amount if he had spent ___?___ cents on each of the 5 days.

The number you have just found is the amount he spent daily *on the average.*

2. How do you find an average?

3. How does the average of 15 different numbers compare with the smallest of the 15 numbers? with the largest?

4. In six baseball games Ray and Ted batted the same number of times and had the following number of hits:

Ray	2	3	4	3	2	4
Ted	3	3	3	3	3	3

Ray said he was the better hitter because he had 4 hits in two games but Ted never had more than 3 hits.

Ted said he was as good a hitter as Ray because they both had a total of 18 hits for the 6 games.

- Do you agree with Ray or with Ted?
- What was Ray's average number of hits per game?
- What was Ted's average number of hits per game?

5. From September through May, George kept a record of the weather bureau's report of the monthly rainfall in inches. His record showed these values: 1.9″, 2.8″, 5.0″, 5.6″, 4.9″, 3.9″, 3.0″, 2.4″, 1.9″.

The average monthly rainfall for the school year was ___?___ inches.

6. From June through August (Ex. 5) the rainfall was 1.3″, 0.6″, 0.7″. What was the average monthly rainfall for the whole year?

7. Frances Macomber's scores on 6 tests of 25 examples each were 18, 21, 24, 20, 23, 25. What was her average score to the nearest tenth?

8. These are the times for four runners in a mile relay race: 56 sec., 54 sec., 57 sec., and 53 sec. Each runner ran a quarter mile. What was the average time per quarter mile?

9. In a seventh-grade reading test Thomas Wood read 745 words in 4 minutes. His reading rate was ___?___ words a minute. Express your answer to the nearest tenth.

10. Explain how you would find the average of 5 numbers.

If a stands for the first number, b for the second, and so on, the average can be written this way:

$$\text{Average} = \frac{a + b + c + d + e}{5}.$$

Can you explain what this statement means?

Tenths of a cent

We have no coin that is smaller in value than a cent. And yet we see prices quoted in tenths of a cent. For example, gasoline may be 28.6 cents a gallon.

A tax rate is often given in cents and tenths of a cent per dollar. A property tax rate of 2.8 cents means that a tax of 2.8 cents has to be paid for each dollar of the taxation (assessed) value of the property.

1. You know that 28 cents is 28 hundredths of a dollar, or \$.28. Can you write 28.6 cents as a decimal part of a dollar?

2. One cent is $\frac{1}{100}$ of a dollar.
$\frac{1}{10}$ of a cent is $\frac{1}{10}$ of $\frac{1}{100}$ of a dollar.
$\frac{1}{10}$ of $\frac{1}{100} = \underline{\ ?\ }$ $.1 \text{ cent} = \$.\underline{\ ?\ }$

3. $.2 \text{ cent} = \$.\underline{\ ?\ }$ $.6 \text{ cent} = \$.\underline{\ ?\ }$
$.3 \text{ cent} = \$.\underline{\ ?\ }$ $.8 \text{ cent} = \$.\underline{\ ?\ }$
$.5 \text{ cent} = \$.\underline{\ ?\ }$ $.9 \text{ cent} = \$.\underline{\ ?\ }$
$\frac{1}{2} \text{ cent} = .5 \text{ cent} = \$.\underline{\ ?\ }$

4. $2¢ = \$.\underline{\ ?\ }$ $13.2¢ = \$.\underline{\ ?\ }$
$37.5¢ = \$.\underline{\ ?\ }$ $21.7¢ = \$.\underline{\ ?\ }$
$2.8¢ = \$.\underline{\ ?\ }$ $6.8¢ = \$.\underline{\ ?\ }$
$87.5¢ = \$.\underline{\ ?\ }$ $6.5¢ = \$.\underline{\ ?\ }$

5. At 28.6 cents a gallon, how much would 15 gallons of gasoline cost?

$$\boxed{\begin{array}{r} \$.286 \\ \underline{\times 15} \end{array}}$$

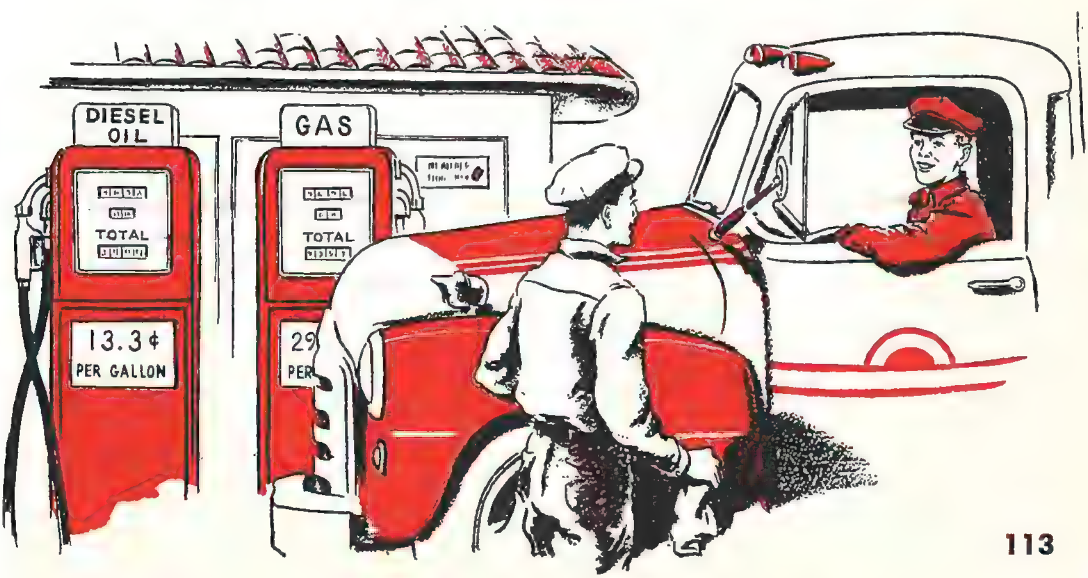
6. If milk is selling at 19.4 cents a quart, how much would 31 quarts of milk cost?

7. In Cloverdale the tax rate on property is 2.8 cents per dollar.

The owner of a house that, for the purpose of taxation, is worth \$10,000 pays a tax of 10,000 times \$.028, or $\$\underline{\ ?\ }$.

8. The driver of the Diesel-powered truck shown below has just bought 35 gallons of fuel oil.

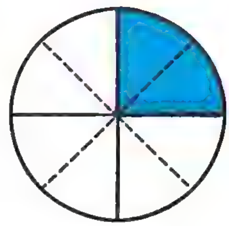
How much did he have to pay for the fuel oil?



Changing fractions to decimals

1. You already know that a whole is 10 tenths, or 100 hundredths. Check the following statements:

- $\frac{1}{2} = \frac{1}{2}$ of 10 tenths = 5 tenths = .5
- $\frac{1}{2} = \frac{1}{2}$ of 100 hundredths = 50 hundredths = .50
- $\frac{1}{5} = \frac{1}{5}$ of 100 hundredths = 20 hundredths = .20
- $\frac{1}{4} = \frac{1}{4}$ of 100 hundredths = 25 hundredths = .25



2. Tom uses this diagram to show that $\frac{1}{8} = \frac{1}{2}$ of $\frac{1}{4}$.
Then he can see that $\frac{1}{8} = \frac{1}{2}$ of $.25 = .12\frac{1}{2}$.
He can also see that $\frac{3}{8} = 3 \times .12\frac{1}{2} = .37\frac{1}{2}$.
How do you think Tom finds that $\frac{5}{8} = .62\frac{1}{2}$? that $\frac{7}{8} = .87\frac{1}{2}$?

$$8\overline{)5.00} = .62\frac{1}{2} \qquad 8\overline{)5.000} = .625$$

3. Joe wanted to change $\frac{5}{8}$ to a decimal. He said, "$\frac{5}{8}$ means $5 \div 8$." So he divided 5 by 8 as shown.
He found that $\frac{5}{8} = .62\frac{1}{2}$, or _?_. Explain why $.62\frac{1}{2} = .625$.

4. Frank wanted to change $\frac{3}{7}$ to a decimal to the nearest hundredth. He used Joe's idea. He divided 3 by 7.
Why did he carry his quotient to 3 decimal places? How did he get .43 for his answer?

$$7\overline{)3.000} = .428 = .43$$

5. Can you make a rule for changing a common fraction to a decimal?

> **To change a common fraction to a decimal, divide the numerator by the denominator.**

6. Change to decimals expressed to the nearest hundredth:

$\frac{5}{7}$ $\frac{2}{9}$ $\frac{5}{9}$ $\frac{1}{11}$ $\frac{17}{23}$ $\frac{11}{27}$ $\frac{42}{53}$

7. The Spitfires won $\frac{5}{8}$ of the ball games they played this season. The Rockets won .54 of their games. Which team has the higher standing?

8. What is an easy way to find which is larger, $\frac{4}{9}$ or .46?

9. Decimal equivalents of some fractions are used so frequently that you should know them by heart. Do you know the following?

$\frac{1}{2} = .5 = .50$	$\frac{2}{3} = .66\frac{2}{3}$	$\frac{2}{5} = .4 = .40$	$\frac{1}{8} = .12\frac{1}{2} = .125$
$\frac{1}{4} = .25$	$\frac{1}{10} = .1 = .10$	$\frac{3}{5} = .6 = .60$	$\frac{3}{8} = .37\frac{1}{2} = .375$
$\frac{3}{4} = .75$	$\frac{1}{5} = .2 = .20$	$\frac{7}{10} = .7 = .70$	$\frac{5}{8} = .62\frac{1}{2} = .625$
$\frac{1}{3} = .33\frac{1}{3}$	$\frac{3}{10} = .3 = .30$	$\frac{4}{5} = .8 = .80$	$\frac{7}{8} = .87\frac{1}{2} = .875$

Changing decimals to fractions

1. Copy and complete this table of equivalent decimals and fractions:→

$\frac{1}{8}$	$\frac{1}{4}$	$\frac{3}{8}$	?	?	?	?
.125	.25	.375	.5	.625	.75	.875

2. Find .25 × 20 mentally. Think: $\frac{1}{4}$ of 20 = _?_.

Do the following multiplications mentally by using the fractional equivalents of the decimals:

	a	*b*	*c*	*d*	*e*
3.	.50 × 24	.25 × 24	.125 × 24	$.66\frac{2}{3}$ × 24	.30 × 25
4.	.80 × 25	.40 × 25	.375 × 24	$.33\frac{1}{3}$ × 24	.70 × 25
5.	.75 × 24	.60 × 25	.875 × 24	.625 × 24	.90 × 25

6. Study the following illustrations of changing a decimal to a fraction. Then make a rule for changing any decimal to a fraction.

$.17 = \frac{17}{100}$ $\qquad .35 = \frac{35}{100} = \frac{7}{20}$ $\qquad .82\frac{1}{2} = .825 = \frac{825}{1000} = \frac{33}{40}$

Change these decimals to common fractions in lowest terms:

7.	.45	.15	.65	.36	.235	.35	.85
8.	.38	.95	.06	.09	$.42\frac{1}{2}$	.25	$.12\frac{1}{2}$

Which is easier to find:

	a	*b*	*c*
9.	$.33\frac{1}{3}$ × 15, or $\frac{1}{3}$ of 15?	$\frac{5}{8}$ of 24, or .625 × 24?	.25 × 16, or $\frac{1}{4}$ of 16?
10.	.35 × 68, or $\frac{7}{20}$ of 68?	.80 × 60, or $\frac{4}{5}$ of 60?	.80 × 29, or $\frac{4}{5}$ of 29?
11.	.60 × 45, or $\frac{3}{5}$ of 45?	$\frac{3}{4}$ of 35, or .75 × 35?	$\frac{2}{3}$ of 36, or $.66\frac{2}{3}$ of 36?

Do these problems without pencil and paper:

12. If $.12\frac{1}{2}$ of the 432 students are absent, how many are absent?

13. $.87\frac{1}{2}$ of the 32 students in Miss Keller's class do good work in arithmetic. How many in that class do good work in arithmetic?

14. Tom saved .25 of the \$1.60 he earned. He put _?_¢ in his savings.

15. In one week Frank sold neckties worth \$30. If he can keep $.33\frac{1}{3}$ of the \$30, how much can he keep?

Fractional parts of a dollar

What you have done on the preceding pages helps you to understand more clearly some fraction and decimal equivalents you have used for several years.

1. Copy and fill in the blanks:
Half a dollar is $\$.\underline{\ ?\ }$.
A quarter of a dollar is $\$.\underline{\ ?\ }$.
75 cents is $\underline{\ ?\ }$ quarters of a dollar.
$\frac{1}{10}$ of a dollar is $\underline{\ ?\ }$ cents.

2. Copy and fill in the blanks:
$\frac{1}{5}$ of a dollar $= \$.\underline{\ ?\ }$
$\frac{2}{5}$ of a dollar $= \$.\underline{\ ?\ }$
$\frac{3}{5}$ of a dollar $= \$.\underline{\ ?\ }$
$\frac{4}{5}$ of a dollar $= \$.\underline{\ ?\ }$
$\$.33\frac{1}{3} = \underline{\ ?\ }$ of a dollar
$\$.66\frac{2}{3} = \underline{\ ?\ }$ of a dollar
$\$.12\frac{1}{2}$ or $\$.125 = \underline{\ ?\ }$ of a dollar
$\frac{3}{8}$ of a dollar $= \$.\underline{\ ?\ }$
$\frac{5}{8}$ of a dollar $= \$.\underline{\ ?\ }$
$\frac{7}{8}$ of a dollar $= \$.\underline{\ ?\ }$

Do Exs. 3–15 mentally by using fractional equivalents:

3. What is the cost of 8 pairs of socks at 50 cents a pair?

4. Find the cost of 32 class caps at $\$.75$ each.

5. The seventh-grade class sold 200 tickets to their fair at $\$.25$ each. What was the total value of the tickets?

6. The wholesaler's catalogue quoted boxes of crayons at $37\frac{1}{2}$ cents each. What would be the cost of 24 boxes?

7. Find the cost of 8 shirts at $\$2.25$ each.

	a	*b*
8.	$40 \times \$.37\frac{1}{2}$	$21 \times \$.66\frac{2}{3}$
9.	$20 \times \$.62\frac{1}{2}$	$18 \times \$.33\frac{1}{3}$
10.	$24 \times \$.87\frac{1}{2}$	$88 \times \$.25$
11.	$96 \times \$.33\frac{1}{3}$	$27 \times \$.66\frac{2}{3}$
12.	$32 \times \$.62\frac{1}{2}$	$48 \times \$.62\frac{1}{2}$
13.	$40 \times \$.87\frac{1}{2}$	$72 \times \$.12\frac{1}{2}$
14.	$80 \times \$.12\frac{1}{2}$	$12 \times \$.12\frac{1}{2}$
15.	$64 \times \$.37\frac{1}{2}$	$56 \times \$.87\frac{1}{2}$

16. Mary bought 5 cans of corn, 4 boxes of cereal, and 3 cans of peas at the store shown in the illustration. How much did Mary spend?

Oral practice with decimals

Tell whether the statements in Exs. 1–15 are true or false:

1. Any fraction can be changed to a decimal.

2. Any decimal can be changed to a fraction.

3. The position of the decimal point in a decimal is of little importance.

4. If you move the decimal point in a number one place to the right, the number is increased by 10.

5. If you move the decimal point in a number one place to the left, the number is divided by 10.

6. Multiplying a number by .1 divides it by 10.

7. Dividing a number by .1 multiplies it by 10.

8. 2.4 is 10 times .24

9. .35 is $\frac{1}{10}$ of 3.5

10. .01 is $\frac{1}{10}$ of .1

11. .1 is 10 times .01

12. .01 is $\frac{1}{10}$ of 1

13. 100 times .01 is 10

14. .001 is $\frac{1}{10}$ of .01

15. .01 is 10 times .001

Tell the missing numbers:

16.	24.0	2.40	.24	?	?
17.	.012	.12	1.2	?	?
18.	.11	1.1	?	?	1100

19. If $.03 \times .2 = .006$, then $.006 \div .03 =$?.

20. In .4123 what is the value of the 4? the 3?

21. $.654 = .05 + .004 +$?.

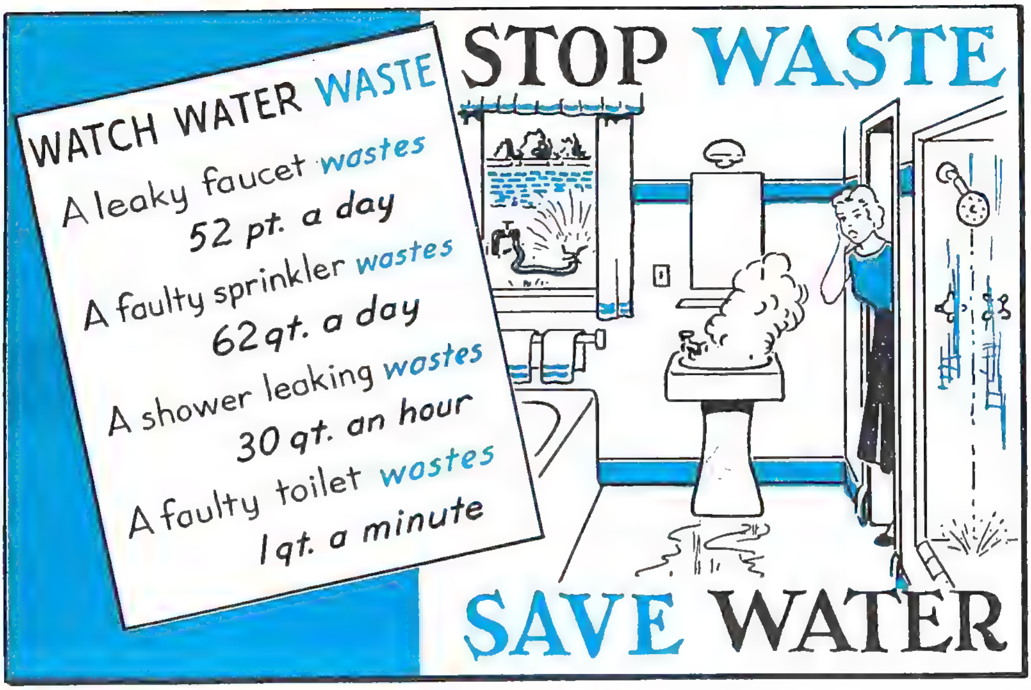
22. Is $6.45 + 4.62$ nearer to 10 or 11? Answer by estimating.

23. Is 4.356×2.467 nearer to 10 or 12? Answer by estimating.

What number does N stand for in Exs. 24–33:

	a	*b*
24.	$N \times .2 = 1$	$N \times .01 = 1$
25.	$N \times .02 = 1$	$N \times 2.5 = .25$
26.	$.3 \times N = 3$	$.2 \times N = 4$
27.	$.01 \times N = 2$	$.01 \times N = 1.1$
28.	$.1 \times N = .01$	$.1 \times N = 1$
29.	$.1 \times N = 10$	$.2 \times N = 20$
30.	$N \times 1.1 = .11$	$N \times .11 = .11$
31.	$N \times .11 = 11$	$N \times 1.1 = 110$
32.	$N \times 1.2 = 12$	$N \times 1.2 = .12$
33.	$N \times 1.2 = 1.2$	$N \times 1.2 = 120$

To the teacher: See Note 9 on page 303.



Using decimals

1. Use the picture to help you find these amounts of wasted water:

- pints an hour from a leaky faucet;
- quarts an hour from a faulty sprinkler;
- pints a minute from a leaky shower;
- gallons a day from a faulty toilet.

2. An electric dishwasher saves on the average 18.23 minutes a day.

To the nearest minute, that would be _?_ hr. _?_ min. in a week.

3. Jim read on a local map that the highest point in the town is 199.4 feet above sea level and that the lowest point is 75.7 feet above sea level.

What is the difference between the highest and the lowest point?

4. The rainfall in Montague Falls for each of twelve months last year was recorded as follows:

3.81″	2.57″	2.33″	4.07″
5.63″	3.09″	3.52″	3.66″
4.03″	3.10″	5.43″	2.01″

What was the total rainfall for the year?

If the total rainfall for the preceding 10 years was 483.54″, was last year's rainfall more or less than the yearly average for the preceding 10 years?

5. The city of Mansfield covers 32 square miles and has a population of 149,554 persons.

That is _?_ persons to the square mile on the average. Give your answer to the nearest whole number.

Decimals

Group 1

Choose the correct statement or answer:

1.	$\frac{3}{4} = .7$	$\frac{3}{4}$ is greater than .7	.7 is greater than $\frac{3}{4}$	
2.	$6\frac{1}{2} = 6.5$	$6\frac{1}{2}$ is greater than 6.5	6.5 is greater than $6\frac{1}{2}$	
3.	9.00 is greater than 9.0	9.00 is less than 9.0	9.0 = 9.00	
4.	.364 is read	3 and 64 thousandths	364 thousandths	364 tenths

5. When counting by tenths the next number after .9 is

   1.0   10.   .01

6. When counting by hundredths the next number after .29 is

   30   3   .30

7. .3 is greater than .26   .3 is less than .26

8. .48 is between   47 and 49   .40 and .50

9. 32.7 is greater than 32.4 by   3   .3

10.	$4 \times 7.2 =$	28.8	288	2.88
11.	$.3 + .3 =$	.09	.6	3.3
12.	$.75 - .73 =$	.2	.148	.02
13.	$4.3 \times 2.1 =$	9.03	90.3	903
14.	$7\overline{)566.3} =$	809	80.9	8.09

15. The sum of 19.8 and 21.3 is nearer 40 than 41; nearer 41 than 40.

16. The difference between 60 and 39.3 is

    less than 20; than 20.3; greater than 20.

17. The product of .3 and .4 is less than $\frac{1}{4}$; equal to $\frac{1}{4}$; greater than $\frac{1}{4}$.

Group 2

1. Write in words 4.063.

2. Compare 2 with 2.0.

3. Which is greater .6 or .56? Explain your method of determining the answer.

4. How much more is .60 than .06?

5. Write $7\frac{3}{4}$ in decimal notation (form).

6. Between what two whole numbers is 16.13?

7. Write in decimal notation: 5 and 56 thousandths.

8. $100 \times 32 =$ ___?___

9. $100 \times 3.2 =$ ___?___

10. $10 \times 64 =$ ___?___

11. $10 \times .64 =$ ___?___

12. $59.63 \times 6.2 =$ ___?___

13. $.006 \times 9.2 =$ ___?___

14. Add: $9.63 + 3.24 + 8.73$

15. Subtract 9.83 from 14.2.

16. Divide 58.563 by 8.1.

17. Divide 37.358 by 6.2.

18. $64 \div 10 =$ ___?___

19. $6.4 \div 10 =$ ___?___

20. $320 \div 100 =$ ___?___

21. $3.2 \div 100 =$ ___?___

22. Divide 23 by 9 and give your quotient to the nearest hundredth.

Which of the following statements are true?

23. The 3 in 3.6 has a value of 5 times that of the value of the 6.

24. The value of the 8 in .048 is one-fifth of the value of the 4.

25. The missing number is 2.00

1.97 1.98 1.99 ___?___.

26. The quotient of 12.03 divided by 1.99 is less than 2.

27. The quotient of 172.4 divided by 2.3 is equal to the quotient of 1724 divided by 23.

28. A 2-place decimal is larger than a 1-place decimal.

29. The value of any digit in tenths place is $\frac{1}{10}$ the value of that digit in tens place.

Decimals

▶ Group 3

1. Explain a method for each of the following:

a Comparing two decimals such as .3 and .26.
b Adding and subtracting decimals.
c Placing a decimal point in a product by estimate.
d Placing a decimal point in a product by rule.
e Multiplying by 10, by 100, or by 1000.
f Dividing by a decimal.
g Dividing by 10, by 100, or by 1000.
h Giving the quotient to the nearest tenth or hundredth.

2. Change $\frac{4}{11}$ to a decimal (to the nearest thousandth).

3. Add 9.87, 4.21, 6.35, 5.49, and 1.25.

4. Subtract 32.918 from 50.906.

5. Multiply 973.5 by .89.

6. Divide 463.2 by .64 and give your answer to the nearest tenth.

7. Joe said that 18 tenths divided by 3 tenths is 6 tenths. Tom said that the answer is 6. Who was correct?

8. Complete: The thickness of a sheet of paper is nearer

.1 inch   .0001 inch.

9. Complete: one one-thousandth of a mile is nearer

50 ft.   5 ft.   .5 ft.   .05 ft.

10. Don estimated the quotient of 101.92 divided by .329 to be slightly larger than 300. What is your estimate?

11. In Ex. 10, Mary estimated that the quotient was close to 306. How do you think she did it?

12. Compute the quotient in Ex. 10, to the nearest whole number.

13. In doing the division $.025\overline{)17.55}$ Bob multiplied both the divisor and dividend by 40. Why do you think he did so?

14. Can you use Bob's method (Ex. 13) to divide 8.04 by .02?

15. Estimate the quotient of 100 divided by 1.6. Then compute the quotient.

16. Estimate the product of 365.2 and 4,602. Then compute the product.

17. Give $\frac{5}{12}$ as a decimal to the nearest thousandth.

18. Add 11.72, 13.51, 9.02, and 2.27.

Holding your ground

Oral review

1. Which is larger, $\frac{1}{2}$ or $\frac{1}{3}$?

2. Find $\frac{1}{5}$ of 275.

3. To reduce a fraction, you should __?__ the numerator and the denominator by the __?__ number.

4. Change to whole or mixed numbers. Fractions in your answers should be reduced to lowest terms.

$\frac{4}{4}$	$\frac{6}{5}$	$\frac{10}{6}$	$\frac{7}{7}$	$\frac{15}{5}$
$\frac{24}{8}$	$\frac{10}{8}$	$\frac{17}{5}$	$\frac{15}{6}$	$\frac{16}{3}$

5. Eight inches is __?__ of a foot.

6. Express 24,680 to the nearest hundred.

7. Change to improper fractions:

$7\frac{1}{2}$	$3\frac{3}{4}$	$5\frac{1}{6}$	$2\frac{2}{5}$	$9\frac{7}{8}$
$6\frac{4}{5}$	$4\frac{5}{6}$	$7\frac{2}{3}$	$1\frac{3}{8}$	$8\frac{1}{4}$

Divide:

8. $8\overline{)72}$ $8\overline{)36}$ $8\overline{)57}$ $8\overline{)67}$

9. $8\overline{)30}$ $8\overline{)74}$ $8\overline{)79}$ $8\overline{)43}$

10. Express $7\frac{1}{2}$ as a decimal.

11. What is $2\frac{7}{8}$ in. to the nearest half inch?

12. Divide the following by 100:

9 9.4 8.23 45.6 .8 .09

13. What is the value of the 6 in 34.62? in 36.84? in 2.086?

14. Frank was on the train from 8:45 P.M. until 7:30 the next morning. How many hours was he on the train?

15. Answer these questions:

- How many hundredths make 1 tenth?
- How many tenths make 1 whole?
- How many units make 1 ten?
- How many tens make 1 hundred?
- How many hundreds make 1 thousand?

16. $10 \times 6 =$ __?__ $20 \times 6 =$ __?__
$30 \times 6 =$ __?__ $40 \times 6 =$ __?__
$50 \times 6 =$ __?__ $60 \times 6 =$ __?__

17. How do you check a subtraction example?

18. How do you check a division example?

19. How much will 8 yd. of material cost at 75¢ a yard? (Use a fractional equivalent for 75 cents.)

20. How would you find $\frac{1}{13}$ of a number?

21. $\frac{3}{4}$ of 16 = __?__ $\frac{2}{3}$ of 15 = __?__
$\frac{5}{6}$ of 12 = __?__ $\frac{3}{5}$ of 20 = __?__

22. What time is it in California when it is 8 A.M. in New York?

23. Which is greater, .1 mile or .02 mile? How much greater?

Holding your ground

▶ Written review

1. Mr. Spear sold 11 calves, each 8 weeks old, for \$264. What was the average price per calf?

2. Subtract 4647 from 7000.

3. If grapefruit are selling at the rate of 4 for 37 cents, how much will 2 dozen cost?

4. On a map the scale reads: "1 in. = 150 mi." A distance of $3\frac{1}{2}$ in. on the map would equal how many miles?

	a	*b*	*c*
5.	$3\frac{1}{2} \times 4$	$5 \times 16\frac{1}{2}$	$6\frac{3}{4} \times 8$
6.	$6 \div \frac{1}{2}$	$18 \div \frac{2}{3}$	$5\frac{1}{2} \div 2\frac{3}{4}$
7.	$22\overline{)836}$	$42\overline{)8652}$	$39\overline{)3354}$
8.	$\begin{array}{r} 5\frac{5}{12} \\ \frac{3}{8} \\ \underline{9\frac{1}{2}} \end{array}$	$\begin{array}{r} 6\frac{9}{10} \\ 2\frac{1}{3} \\ \underline{4\frac{1}{2}} \end{array}$	$\begin{array}{r} 7\frac{1}{4} \\ 3\frac{1}{8} \\ \underline{1\frac{5}{6}} \end{array}$
9.	$\begin{array}{r} 8 \\ \underline{-\ 2\frac{4}{9}} \end{array}$	$\begin{array}{r} 5\frac{3}{5} \\ \underline{-\ 4\frac{3}{4}} \end{array}$	$\begin{array}{r} 18\frac{5}{6} \\ \underline{-\ 2\frac{3}{4}} \end{array}$

10. How much change would you get from a 10-dollar bill after buying 18 yd. of toweling at $42\frac{1}{2}$ cents a yard?

11. Write this number in figures: 7 billion, 7 million, 7 thousand.

12. Change $2\frac{1}{2}$ yards to inches.

13. Write the number that is 1 less than 34,010.

14. How many feet are there in $2\frac{2}{3}$ yd.?

15. What is the cost of $19\frac{3}{4}$ dozen eggs at 79 cents a dozen? (In your answer, call a fraction of a cent another cent.)

16. If 3 teaspoonfuls make 1 tablespoonful, 16 tablespoonfuls make 1 cup, and 2 cups make a pint, how many teaspoonfuls are there in a pint?

17. Traveling at the rate of 40 miles an hour, how long will an automobile take to go 220 miles?

18. Mary paid 75 cents a yard for $3\frac{1}{2}$ yards of dress goods, 75 cents for trimmings, and \$2.00 for having the dress made.

She could have bought a ready-made dress for \$5.00. How much would she have saved?

Just for fun

Write the year of your birth.

Under that write the year you started school.

Write how many years ago that was.

Write your age as of this year's birthday.

Add all four numbers.

One half the sum is __?__.

Self-Help Test 3

The number at the right of each example tells you the page on which you can find help for that kind of example.

1. $\frac{4}{5}=\frac{?}{15}$ (65) **2.** $\frac{3}{5}\times\frac{1}{7}$ (75) **3.** $1\frac{2}{3}\times 6$ (76) **4.** $\frac{8}{9}\times\frac{15}{16}$ (75)

5. $2\frac{1}{4}\times\frac{1}{3}$ (76) **6.** $3\frac{1}{3}\times 1\frac{2}{5}$ (76) **7.** $1\frac{2}{3}\div\frac{10}{11}$ (78) **8.** $2\frac{1}{4}\div 3$ (78)

9. $4\frac{2}{3}\div 2\frac{1}{3}$ (78) **10.** $2\div\frac{1}{2}$ (77) **11.** $2\frac{3}{8}+4\frac{1}{2}+2\frac{3}{4}$ (68) **12.** $5\frac{1}{3}-2\frac{3}{4}$ (69)

13. $3.25 + 4.63$ (96) **14.** $26.75 - 25.50$ (96) **15.** 87.35 from 100 (96)

16. $5 - 2.5$ (96) **17.** $2.4 - .8$ (96) **18.** $.294 \times 10$ (100)

19. 56.7×4.5 (98) **20.** $794.3 \times .7$ (98) **21.** $25.8 \times .07$ (98)

22. 7.256×100 (100) **23.** $72.56 \div 1000$ (107) **24.** $5.4\overline{)143}$ to tenths (111)

25. $6\overline{)17.838}$ to thousandths (111) **26.** $11.9\overline{).35}$ to thousandths (111)

27. Write the decimal equivalents of: $\frac{1}{2}$ $\frac{3}{4}$ $\frac{1}{3}$ $\frac{4}{5}$ $\frac{2}{5}$ (114)

Self-Help Test 4

1. Write each of these numbers in two other ways: $\$7\frac{1}{2}$ million; 3,250,000 dollars (3)

2. Write in figures: nine billion, nine hundred nine thousand. (3)

3. Bob should weigh 70 lb. for his height. He weighs only $62\frac{3}{4}$ lb. He is __?__ lb. underweight. (69)

4. Write in figures: three hundred three thousandths. (95)

5. Round off to the nearest tenth:
9.86 9.83 209.07 147.61 (110)

6. Of the following three numbers, which one is the largest?
.06 .60 6.0 (93)

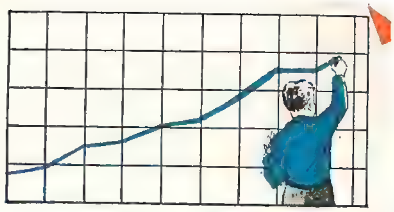
7. Divide 769 by 76. Express the answer to the nearest hundredth. (111)

8. Find the difference between 8000 and 276.56. (96)

9. Find the product of 384.63 and 7.8. (98)

10. What is the cost of one pound of lawn seed if a 10-pound bag costs $10.50? (107)

Measuring your growth in arithmetic



Test 3a

1. Add and check: 204.07, 365.79, and 427.003.

2. Subtract 206 thousandths from 75 hundredths.

3. Multiply 279.8 by .006

4. 96 books at $2.24 each cost ___?___.

5. Is .036 greater or less than .04? How much?

6. Floor boards can be bought for $75 a thousand feet. This is at the rate of ___?___ per foot.

7. At 12.5 cents a foot, what is the cost of 100 feet of wire fencing?

8. What is the cost of 16 books at 75 cents each? (Use a fractional equivalent.)

9. What is the total cost of 500 telephone calls at $.045 a call, and 50 more calls at $.0425 a call?

10. Tom needs to find which of the numbers $12\frac{5}{8}$ and 12.509 is larger.
Show how he should find out. The difference between the numbers is ___?___.

Test 3b

1. Divide 278.6 by 2.9 and give your answer to the nearest hundredth.

2. A wire is .10 inch thick. How many such wires laid side by side will it take to measure 1 inch?

3. Change $\frac{8}{9}$ to a decimal correct to the nearest thousandth.

4. Mr. Grant figures that he drives 19.9 miles on a gallon of gasoline. On 25 gallons will he go about 50, 500, or 5000 miles?

5. A bus made the trip between two cities in 1.5 hr. The speedometer showed 45.3 miles for the trip. The average speed in miles per hour was ___?___.

6. It costs Mr. Hunt 6.3 cents a mile to drive his car. How much, to the nearest cent, does it cost him to drive to work, 2 round trips a day, 5 days a week, 2.7 miles each way?

7. Peter Mills sold his 1000-pound steer for $1160. How much did he receive per pound?

8. A glider has flown to an altitude of 42,000 feet. How many miles is that to the nearest tenth of a mile?

9. Mr. Mason used 790 gallons of fuel oil. At 12.2 cents a gallon, what was the cost of this fuel oil?

10. Which is larger, $\frac{7}{16}$ or $\frac{5}{12}$?

Comparing numbers by using a fraction

1. Jane bought a 6-ounce piece of cheese. The cheese sold for 56¢ a pound. To find the cost of 6 ounces, Jane needed to compare 6 ounces with one pound (16 ounces).

She thought: 6 ounces is $\frac{6}{16}$ or $\frac{3}{8}$ of a pound. $\frac{3}{8}$ of 56¢ = ___?___¢.

2. 1 foot is what part of a yard? Think:

- There are 3 feet in a yard.
- 1 foot compared with 3 feet is the fraction ___?___.
- 1 foot is what part of 3 feet?

3. 2 feet is what part of 3 feet? Is 2 equal to $\frac{2}{3}$ of 3?

4. Is 3 equal to $\frac{3}{4}$ of 4? Check by finding $\frac{3}{4}$ of 4.

5. Is 5 equal to $\frac{5}{7}$ of 7? Check by finding $\frac{5}{7}$ of 7.

To find what part one number is of another, divide the one number by the other.

2 is $\frac{2}{3}$ of 3. 3 is $\frac{3}{4}$ of 4.
5 is $\frac{5}{7}$ of 7. 7 is $\frac{7}{10}$ of 10.
9 is $\frac{9}{12}$ or $\frac{3}{4}$ of 12.

Express each answer as a fraction reduced to lowest terms.

6. 8 ounces is what part of a pound?

7. 9 inches is what part of 45 inches?

8. 7 dollars is what part of 49 dollars?

9. 5 days is what part of 30 days?

10. 8 eggs is what part of a dozen?

11. 3 inches is what part of a yard?

12. 25 cents is what part of a dollar?

13. 4 pints is what part of 2 gallons?

14. 100 yards is what part of a mile?

15. 10 gallons is what part of 25 gallons?

16. 30 minutes is what part of 8 hours?

17. 45 seconds is what part of a minute?

18. 16 is what part of 18?

19. 4 is what part of 14?

20. 27 is what part of 81?

21. 45 is what part of 54?

22. 84 is what part of 200?

23. 48 is what part of 192?

24. Out of 30 problems, John had 15 right, Jane had 18 right, and Alice had 25 right.

What fractional part of the whole number of examples did John have right? Jane? Alice?

Sprays and plant foods

1. Tom wants to spray his vegetable garden. He has a 10-gallon container for mixing the spraying fluid with water. He wants to know how much fluid to use. He thinks:

▶ The directions call for 1 ounce (2 tablespoonfuls) of fluid to 30 gallons of water, but I have only a 10-gallon container.

▶ 10 gallons is what part of 30 gallons?

▶ I must divide 10 by 30. 10 gallons is $\frac{10}{30}$ or __?__ of 30 gallons.

▶ Since I will use $\frac{1}{3}$ as much water, I should also use __?__ as much fluid.

▶ I should use __?__ ounce of fluid.

2. When Tom (Ex. 1) had finished spraying his garden, he found that he had used only 6 gallons of the mixture.

How much fluid would he have needed for 6 gallons of mixture?

3. Using the spraying fluid in Ex. 1, Tom's father makes a mixture with 120 gallons of water. How much spraying fluid should he use? Think:

▶ Compare 120 gallons with 30 gallons.

▶ 120 gallons is $\frac{120}{30}$ or __?__ times 30 gallons.

▶ So the amount of spraying fluid is __?__ ounces.

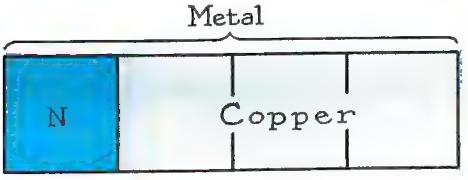
4. Tom's mother uses a liquid plant food for her house plants. The directions say: "$\frac{3}{4}$ tablespoonful for each gallon of water."

How much should she use in one-half gallon of water? ($\frac{1}{2}$ of $\frac{3}{4}$ = __?__.)

5. 6 tablespoonfuls of the plant food (Ex. 4) are enough to mix with __?__ gallons of water. (Think: How many $\frac{3}{4}$ tablespoonfuls are there in 6 tablespoonfuls?)

Mixtures

Five-cent pieces are made of nickel and copper. For every pound of nickel in the metal used for the five-cent pieces there are 3 pounds of copper.



Use the diagram above to help you with the following:

1. How many times as much copper as nickel is used?

2. If 1000 pounds of nickel are used, how much copper should be used?

3. Write a fraction to compare the amount of nickel with the amount of copper.

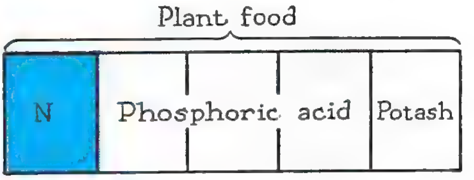
4. If 6000 pounds of copper are used, how much nickel should be used?

5. Write a fraction to compare the amount of nickel used in a five-cent piece with the amount of metal used in it. (1 pound in 4 pounds is _?_.)

6. If 6000 pounds of metal are desired for making five-cent pieces, how much nickel should be used?

7. Write a fraction to compare the amount of copper used in a five-cent piece with the amount of metal used in it. (3 pounds in 4 pounds is _?_.)

The plant foods in a good grade of fertilizer are nitrogen, phosphoric acid, and potash. For every pound of nitrogen in the fertilizer there are 3 pounds of phosphoric acid and 1 pound of potash.



8. If the fertilizer contains 4 pounds of nitrogen, it contains _?_ pounds of phosphoric acid and _?_ pounds of potash.

9. The nitrogen is what part of the total plant food?

10. If the fertilizer contains 20 pounds of plant food, it will contain _?_ pounds of nitrogen, _?_ pounds of phosphoric acid, and _?_ pounds of potash.

11. In a 100-pound bag of the fertilizer, there are 95 pounds of material that helps to distribute the plant food through the soil but does not contain plant food.

For every 100-pound bag of fertilizer there are _?_ pounds of material that contains plant food.

For every 5 bags of fertilizer there are _?_ pounds of material that contains plant food.

Iron ore, coke, and limestone are put into a blast furnace to make cast iron. The temperature range is from 900° Fahrenheit to 3600° Fahrenheit.

For every 4 tons of iron ore, it is necessary to use 2 tons of coke and 1 ton of limestone.

Make a diagram to help you complete the following:

12. There is __?__ times as much ore as limestone.

There is __?__ times as much coke as limestone.

13. There is __?__ times as much ore as coke.

There is __?__ as much limestone as coke.

14. There is __?__ as much limestone as ore.

There is __?__ as much coke as ore.

15. For 12 tons of iron ore, __?__ tons of coke and __?__ tons of limestone would be used.

16. Iron ore is __?__ of the total material put into the furnace.

Limestone is __?__ of the total put into the furnace.

Coke is __?__ of the total put into the furnace.

17. If the furnace contains 28 tons of material, it contains __?__ tons of coke.

18. Consider separately the mixtures from *a* to *h*. For each mixture try to answer the three questions below.

MIXTURES

a. 4 tsp. vanilla and 6 tsp. water
b. 3 cups milk and 2 cups water
c. 4 pt. vinegar and 4 pt. water
d. 3 qt. alcohol and 10 qt. water
e. 4 gal. skim milk and 1 gal. cream
f. 5 lb. oats and 3 lb. wheat
g. 1 cup fruit juice and 10 cups water
h. 2 lb. brown sugar and 5 lb. white sugar

- How much mixture is there all together?
- What is the fraction that compares the amount of each ingredient (material) with the total amount of the mixture?
- What is the fraction that compares the amount of the first ingredient with the amount of the second ingredient?

19. Which mixture in Ex. 18 would you call an equal-part mixture?

20. Which of the following statements are true? (Use the information in Ex. 18.)

- In mixture *a* more than half the mixture is water.
- In mixture *e* more than $\frac{1}{4}$ of the mixture is cream.
- In mixture *g* less than $\frac{1}{10}$ of the mixture is fruit juice.
- In mixture *h* more than $\frac{1}{4}$ of the mixture is brown sugar.

Recipes

TABLE FOR COOKING CEREAL

KIND	QUANTITY	WATER	TIME
Rolled oats	1 cup	2 cups	30 min.
Rice	1 cup	3 cups	45 min.
Whole-wheat cereal	1 cup	6 cups	20 min.

The table above is found in many popular cookbooks. Refer to it in solving these problems.

1. How much water must you use if you use 1 cup of rolled oats? if you use 2 cups of rolled oats? 3 cups? 5 cups?

2. One cup of rolled oats makes enough cereal to serve 4 persons.

Write a fraction to compare the number of cups of rolled oats with the number of persons to be served.

How much rolled oats would you use to make enough cereal for 8 persons? 12 persons? 2 persons? 6 persons? 10 persons?

3. How much water must you use if you use 1 cup of rice? 2 cups of rice? 3 cups? 6 cups?

4. One cup of uncooked rice makes enough cooked rice to serve 6 persons.

Write a fraction to compare the number of cups of uncooked rice with the number of persons to be served.

How much uncooked rice would you use to serve 12 persons?

5. How much water must you use if you use 1 cup of whole-wheat cereal? 2 cups? 3 cups? 4 cups?

6. One cup of whole-wheat cereal gives enough cereal to serve 6 persons.

How many cups of whole-wheat cereal and how many cups of water should you use if you want to serve 12 persons? 18 persons? 3? 9? 4?

7. The quantity of water used should be _?_ times as great as the quantity of rolled oats, _?_ times as great as the quantity of rice, and _?_ times as great as the quantity of whole wheat.

8. Only _?_ as much rolled oats as water is used, _?_ as much rice as water, and _?_ as much whole wheat as water.

9. How much rice should you add to 2 cups of water?

10. How much whole-wheat cereal would you add to 3 cups of water? 2 cups? 1 cup?

11. How much water should you use with $\frac{3}{4}$ cup of rolled oats? $\frac{2}{3}$ cup of rice? $\frac{1}{4}$ cup of whole wheat?

12. A standard cookbook recommends these amounts for serving 2 persons:

Fresh peas	1 lb.
String beans	$\frac{1}{2}$ lb.
Rice (uncooked)	$\frac{1}{4}$ lb.
White potatoes	1 lb.
Asparagus	$\frac{3}{4}$ lb.
Steak with bone	$1\frac{1}{4}$ lb.
Chicken meat	$\frac{3}{4}$ lb.

What amount of each of these foods should you use for 4 persons, if you follow the advice of the cookbook?

What amount of each of these foods should you use for 5 persons?

13. How many pounds of steak (Ex. 12) should you use for 6 persons?

14. How much asparagus (Ex. 12) should you use for 8 persons?

15. Here is a recipe for fruit punch to serve 6 persons:

$\frac{1}{2}$ cup orange juice
$\frac{1}{4}$ cup lemon juice
$\frac{1}{2}$ cup grapefruit juice
1 cup pineapple juice
$1\frac{1}{2}$ cups water
$\frac{1}{2}$ cup sugar syrup

How much of each ingredient should be used to serve 12 persons? 18 persons? 15 persons?

16. If Ann follows the recipe in Ex. 15 but uses $\frac{1}{2}$ cup of lemon juice, how much of each of the other ingredients should she use?

17. Helen was mixing some nut-bread dough. Among other things, the recipe called for the following ingredients:

2 cups graham flour
2 cups buttermilk
1 cup pastry flour
$\frac{2}{3}$ cup brown sugar

How much of each of the ingredients should she use if she wants to make twice as much bread as the recipe makes? if she wants to make 3 times as much? $1\frac{1}{2}$ times as much? $\frac{1}{2}$ as much?

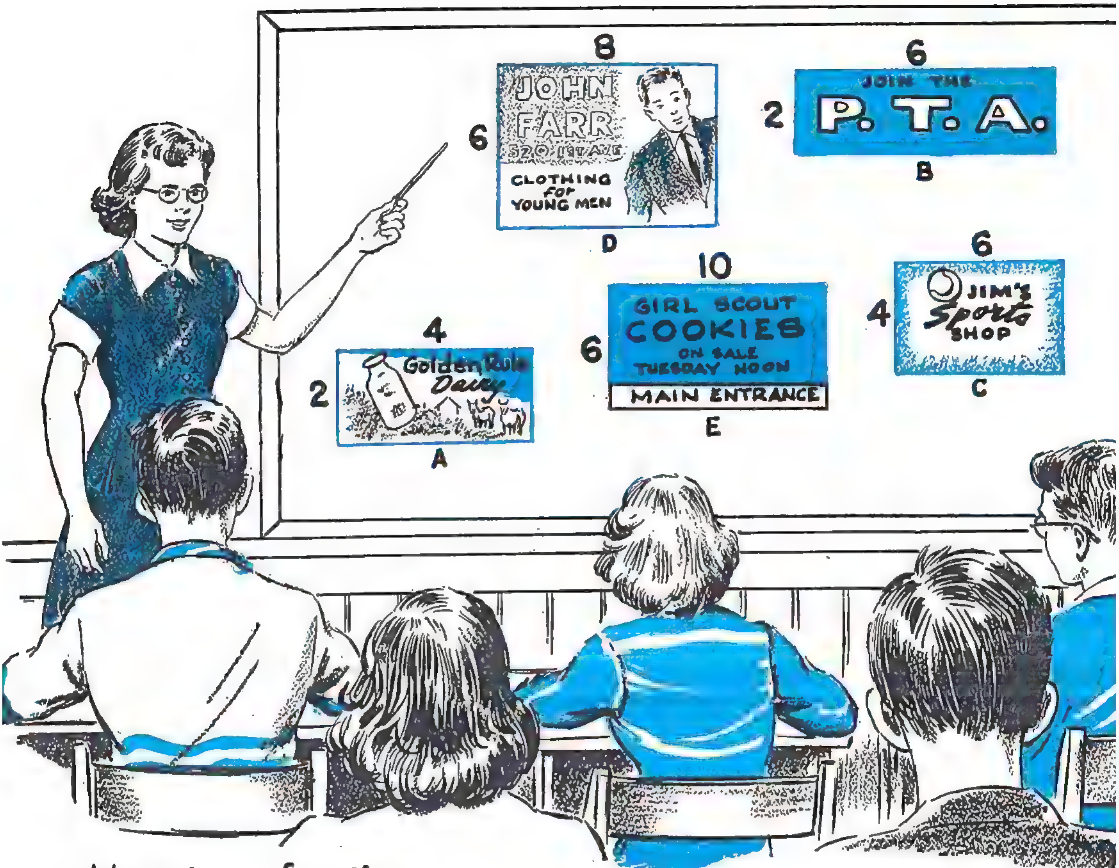
18. How much of each of the other ingredients should Helen (Ex. 17) use if she uses 6 cups of graham flour? 4 cups? 2 cups? 1 cup?

19. How much of each of the other ingredients should Helen (Ex. 17) use if she uses $\frac{1}{2}$ cup of pastry flour? $\frac{1}{4}$ cup of pastry flour? $1\frac{1}{2}$ cups? 2 cups? 3 cups?

20. Helen (Ex. 17) always has to use _?_ times as much graham flour as pastry flour, _?_ times as much buttermilk as pastry flour, and _?_ as much brown sugar as pastry flour.

21. Frances makes corn muffins by using a recipe that calls for $\frac{3}{4}$ cup of corn meal and $1\frac{1}{2}$ cups of white flour. The recipe as it stands is for 16 corn muffins.

To make 8 muffins Frances would use _?_ cup of corn meal and _?_ cup of white flour.



Meaning of ratio

1. The students in a seventh-grade art class plan to make posters.

The teacher told the students that she prefers a poster whose width is about $\frac{3}{5}$ of its length.

Which of the shapes shown on the display board in the illustration would she prefer?

2. Complete: The width of rectangle A is $\frac{2}{4}$ or $\frac{1}{2}$ of its length; the width of B is _?_ of its length; the width of C is _?_ of its length; the width of D is _?_ of its length; and the width of E is _?_ of its length.

3. The art teacher said that a rectangle in which the *ratio* of the width to the length is about $\frac{3}{5}$ has such a pleasing appearance that it is sometimes called the "golden rectangle."

Do you know what she meant by the word *ratio?*

Ratio means comparison by division. To find the ratio of one number to another, you divide the first number by the second.

4. What is the ratio of the width to the length in A? B? C? D? E?

5. Write a fraction to compare:

- the length of rectangle A with its width.
- the length of B with its width.
- the length of C with its width.
- the length of D with its width.
- the length of E with its width.

6. What is the ratio of the length to the width in rectangle A? B? C? D? E?

7. The ratio of 6 to 8 means *6 divided by 8* and equals $\frac{6}{8}$ or $\frac{3}{4}$. The ratio of 8 to 6 means *8 divided by 6* and equals $\frac{?}{?}$ or $\frac{?}{?}$.

8. a and b represent lines 8″ and 12″ long. The ratio of line a to line b is 8 to 12, or 8 ÷ 12, or $\frac{8}{12}$. Reduce $\frac{8}{12}$ to lowest terms.

a 8″

b 12″

9. The ratio of line b to line a is 12 to 8, or $\frac{12}{8}$, or $\frac{?}{2}$.

10. c and d represent lines 6″ and 12″ long. The ratio of c to d is __?__, and the ratio of d to c is __?__.

c 6″

d 12″

11. What is the ratio of:

12 to 16?	16 to 12?	18 to 24?
24 to 18?	36 to 48?	48 to 36?
10 to 100?	100 to 10?	20 to 200?

12. What is the ratio of:

3 to 5?	9 to 12?	12 to 16?
18 to 24?	27 to 36?	75 to 100?

13. Choose 5 pairs of numbers whose ratio is 2 to 3, or $\frac{2}{3}$.

14. Choose 5 pairs of numbers whose ratio is 3 to 2, or $\frac{3}{2}$.

15. When we say that the ratio of two numbers is $\frac{2}{3}$, we mean that the smaller of the numbers is $\frac{2}{3}$ of the larger.

For example, the ratio of 8 to 12 is $\frac{2}{3}$; also 8 is $\frac{2}{3}$ of 12. If the larger number is 18, the smaller number is __?__. If the larger number is 24, the smaller is __?__.

16. When we say that the ratio of two numbers is $\frac{3}{2}$, we mean that the larger is $\frac{3}{2}$ of the smaller.

For example, the ratio of 12 to 8 is $\frac{3}{2}$, and also 12 is $\frac{3}{2}$ of 8. What is the larger number if the smaller number is 10? 16? 20? 28? 100?

17. Line a is 1 inch long; b is $1\frac{1}{4}$ inches; and c is $1\frac{1}{2}$ inches.

a 1″

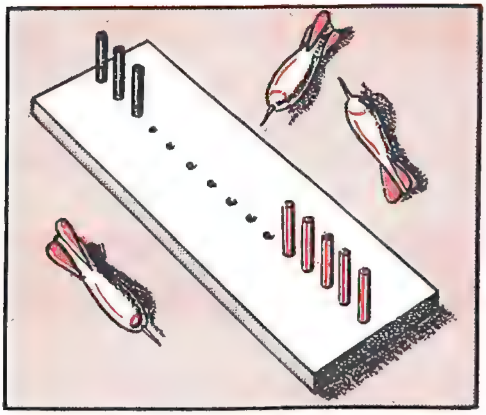
b $1\frac{1}{4}$″

c $1\frac{1}{2}$″

- The ratio of a to b is $1 \div 1\frac{1}{4}$ or $1 \div \frac{5}{4} = \frac{4}{5}$. The ratio of a to b is __?__ to 5.
- The ratio of b to c is __?__.
- The ratio of a to c is __?__.
- The ratio of b to a is __?__.
- The ratio of c to a is __?__.
- The ratio of c to b is __?__.

18. Draw two lines whose ratio is $\frac{2}{3}$; $\frac{3}{4}$; $\frac{3}{2}$; $\frac{4}{3}$.

More practice with ratios



Above is last week's score for the number of games won in darts.

John has 3 pegs for 3 games won.

Ted has 5 pegs for 5 games won.

1. The ratio of 3 pegs to 5 pegs is _?_ to _?_, or $\frac{?}{?}$.

2. Ted has 5 pegs to John's 3. The ratio of 5 pegs to 3 pegs is _?_ to _?_, or $\frac{?}{?}$.

3. In all, the pegs show that _?_ games have been played.

John has won _?_ out of _?_ games.

This is a ratio of _?_ to _?_, or $\frac{?}{?}$.

4. Ted has won _?_ out of _?_ games.

This is a ratio of _?_ to _?_, or $\frac{?}{?}$.

5. What is the ratio of 25 to 5?

As a fraction in lowest terms it is $\frac{?}{?}$.

As a whole number it is _?_.

6. What is the ratio of 8 to 40?

As a fraction in lowest terms it is $\frac{?}{?}$.

As a decimal it is _?_.

7. Betty ran 80 feet and Dick ran 100 feet in an obstacle race. Which of the following statements are *true* and which are *false?*

- 80 feet is $\frac{80}{100}$ or $\frac{4}{5}$ as long as 100 ft.
- The ratio of 80 to 100 is .8, or $\frac{8}{10}$.
- The ratio of 100 to 80 is 4 to 5.
- 100 is $\frac{5}{4}$ as large as 80.

8. The ratio of 40 seconds to 2 minutes, written as a fraction in lowest terms, is $\frac{?}{?}$.

9. The ratio of 2 chickens to 1 dozen chickens is _?_ to _?_.

10. The ratio of 40 minutes to 1 hour is _?_ to _?_.

11. Does the fraction $\frac{1}{4}$ express the ratio of 3 inches to 1 foot?

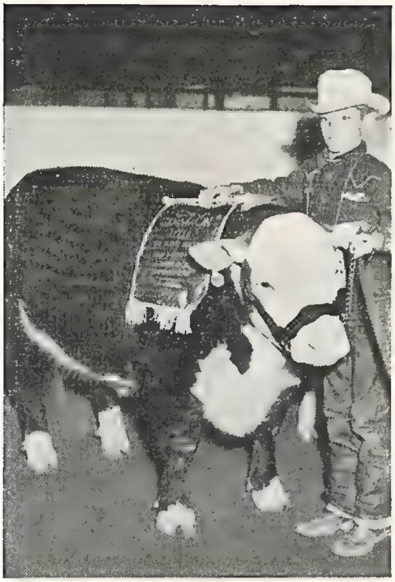
12. Does the fraction $\frac{1}{8}$ express the ratio of a quart to a gallon?

13. What is the ratio of each of the following?

3 in. to 1 yd.	1 yd. to 3 in.
5¢ to $1	$1 to 5¢

14. Mary weighs 80 lb. Her younger brother John weighs 60 lb. Which of the following statements about their weights are true?

- Mary's weight is $\frac{4}{3}$ of John's.
- John's weight is $\frac{3}{4}$ of Mary's.
- If the ratio of their weights does not change, when Mary weighs 100 lb. John will weigh 75 lb.



Enlargements

1. Above at the left is a picture of Harold and his prize steer. Measure the width and the length of the picture. It is _?_ in. wide and _?_ in. long.

The ratio of the width to the length is _?_ to _?_, or $\frac{?}{?}$.

2. It was such a good picture that Harold decided to have it enlarged to the size shown at the right. The enlarged picture is _?_ in. wide and _?_ in. long.

The ratio of the width to the length in the enlargement is _?_ to _?_. Is this ratio the same as 2 to 3? (Does $2 \times 1\frac{1}{2} = 3$? Does $3 \times 1\frac{1}{2} = 4\frac{1}{2}$?)

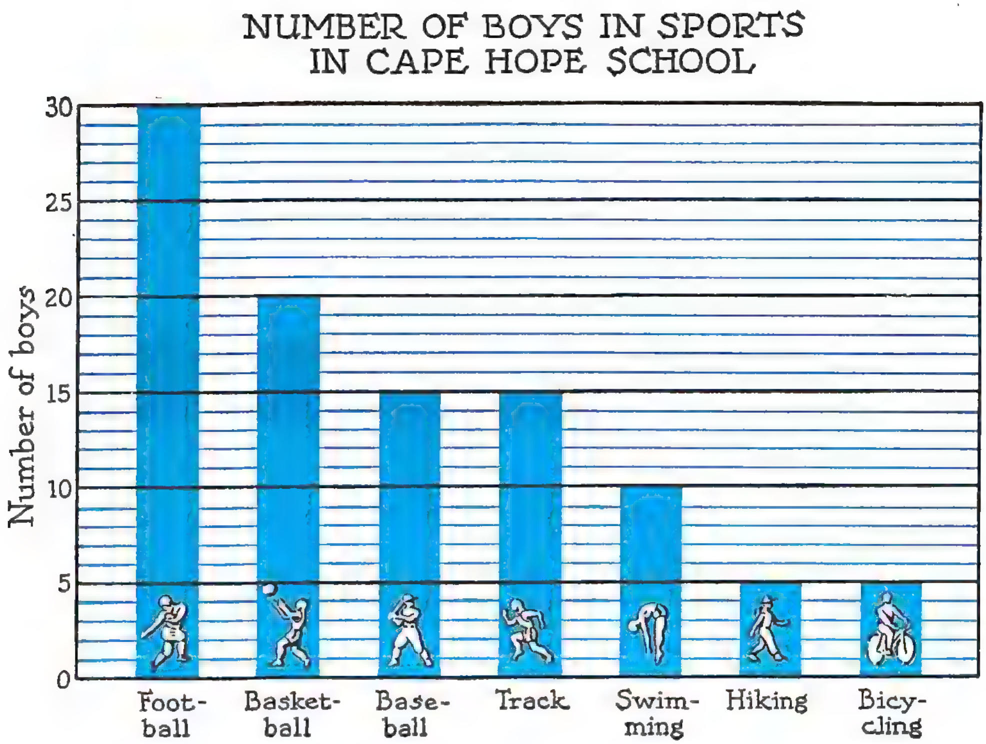
When a picture is enlarged, the ratio of the width to the length is not changed.

3. In Harold's original picture (Ex. 1), the ratio of the length to the width is _?_ to _?_.

4. If Harold's original picture is enlarged to be 4 in. wide, how long will it be? If it is enlarged to be 12 in. long, how wide will it be?

5. If a picture is 6 in. wide and 8 in. long, the ratio of its width to its length is $\frac{?}{?}$; the ratio of its length to its width is $\frac{?}{?}$.

6. If the picture in Ex. 5 is enlarged to be 9 in. wide, how long will it be?



Problems using ratio

1. In Cape Hope School a boy is allowed to be in only one of the activities shown in the graph, and every boy must be in one activity.

How many boys are there in Cape Hope School?

2. Write a fraction to compare the number of boys in each activity with the total number of boys. Give your answer in lowest terms.

3. What is the ratio of the number of boys in football to the number in swimming?

What is the ratio of the number in swimming to the number in football?

4. What is the ratio of the number in basketball to the number in hiking?

What is the ratio of the number in hiking to the number in basketball?

5. What is the ratio of the number in bicycling to the number in track?

6. What is the ratio of the number in baseball to the number in track?

What is the ratio of the number in track to the number in baseball?

7. Name two sports in which the ratio of the number of boys in one to the number of boys in the other is 3 to 2.

8. In this country 1 out of every 5 persons has an automobile. This is a ratio of _?_ to _?_.

In all the world the ratio is 1 to 200. This means that for every 1000 persons, only _?_ have an automobile.

9. A 1–2–4 mixture of concrete means that for every cubic foot of cement, 2 cubic feet of sand and 4 cubic feet of gravel are required.

What is the ratio of the amount of cement to the amount of sand? the amount of cement to the amount of gravel? the amount of sand to the amount of gravel?

10. When 6 cubic feet of cement are used (Ex. 9), how many cubic feet of sand should be used?

11. For packing peaches for freezing, Mrs. Hall uses a syrup that is 1 part sugar to 2 parts water.

What is the ratio of the amount of sugar to the amount of water?

What is the ratio of the amount of water to the amount of sugar?

For 5 cups of sugar, Mrs. Hall would use _?_ cups of water.

12. A good syrup can be made with 2 parts of sugar to 5 parts of water. What is the ratio of water to sugar?

For 5 cups of sugar, _?_ cups of water would be used.

13. Which syrup uses the more sugar for a given amount, one with the ratio of sugar to water, 1 to 2, or one with the ratio of sugar to water, 2 to 5?

14. Bill picks and sells berries for Mr. Cooley. Mr. Cooley divides the money he receives in the ratio 3 to 2, keeping 3 parts for himself to every 2 parts for Bill.

When the receipts are $9.75, Mr. Cooley gets _?_ and Bill gets _?_. (Hint: Since Mr. Cooley keeps 3 parts and gives Bill 2 parts, the total receipts must be equal to _?_ parts.)

15. If Don has $\frac{2}{3}$ as much money as Cynthia, then Cynthia has _?_ as much as Don.

16. The plant food in X–Brand fertilizer is made up of 1 part nitrogen, 2 parts phosphorus, and 1 part potash. The nitrogen is _?_ of the plant food, and the phosphorus is _?_ of the plant food.

17. For every 50 pounds of plant food (Ex. 16), there would be _?_ pounds of potash and _?_ pounds of phosphorus.

18. In the Prince School there are 2 boys to every 3 girls.

- This means that 2 out of every _?_ students are boys.
- There are 500 students in all. Of these _?_ are girls.
- The ratio of the number of girls to the number of students is _?_.

19. John rides 2 miles to school. Bill rides 3 miles. John rides _?_ as far as Bill. Bill rides _?_ as far as John.

True or false?

Tell whether each statement on this page is ***true*** *or* ***false.***

1. In the number 4857 the digit 8 is in *hundreds* place; it stands for or has a value of *800*.

2. If the decimal point in 2.536 were moved 2 places to the right, the number then formed would be *10* times as large as the original number.

3. The zero in 203 tells the number of tens in tens place.

4. In the number 1759 the digit 1 has a value greater than the value of any of the other digits.

5. In a 4-place number the value of the digit in units place is smaller than the value of any other digit.

6. The value of the 3 in 3076 is less than the value of the 3 in 7603.

7. If the 3 in 4302 is changed to 5, the number will be increased 200.

8. The average weight of the boys in your class is about 140 lb.

9. The average height of the girls in your class is about 5 ft. 8 in.

10. The quotient in the second example below is greater than the quotient in the first.

$39\overline{)764}$ $\quad$ $39\overline{)703}$

11. The quotient in the second example below is greater than the quotient in the first.

$27\overline{)800}$ $\quad$ $28\overline{)800}$

12. If a pint of water weighs 1 pound, a gallon weighs 4 pounds.

13. All of these numbers are exactly divisible by 5:

15 $\quad$ 35 $\quad$ 50 $\quad$ 600 $\quad$ 775

14. All of these numbers are exactly divisible by 2:

12 $\quad$ 47 $\quad$ 56 $\quad$ 100 $\quad$ 375

15. All of these numbers are exactly divisible by 10:

20 $\quad$ 60 $\quad$ 240 $\quad$ 1250

16. If the units digit of a number is 3, 6, or 9, the number is exactly divisible by 3.

17. The next number after 19 that is exactly divisible by 3 is 24.

18. The product of 6.1 and 4 is greater than 25.

19. The product of 6.1 and .4 is greater than 4

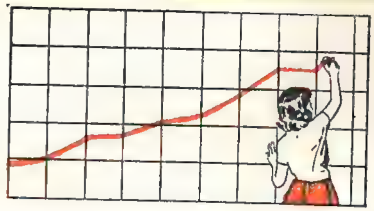
20. When the dividend and the divisor are whole numbers, then the quotient will be a whole number.

21. When the dividend is a whole number and the divisor is a proper fraction, the quotient will be larger than the dividend.

22. If you know that $\frac{3}{4} + \frac{3}{4} + \frac{3}{4} = 2\frac{1}{4}$, then you know that $\frac{1}{3}$ of $2\frac{1}{4}$ is $\frac{3}{4}$.

23. If you know that $\frac{3}{4} + \frac{3}{4} + \frac{3}{4} = 2\frac{1}{4}$, then you know that $2\frac{1}{4} \div \frac{3}{4} = 3$.

Measuring your growth in arithmetic



Test 4a

1. Mary's recipe for pastry calls for $\frac{1}{2}$ cup of shortening to $1\frac{1}{2}$ cups of flour. The amount of flour is __?__ times the amount of shortening.

2. The amount of shortening (Ex. 1) is __?__ of the amount of flour.

3. The ratio of flour to shortening (Ex. 1) is __?__ to __?__.

4. The ratio of shortening to flour (Ex. 1) written as a fraction is __?__.

5. For 12 cups of flour Mary (Ex. 1) should use __?__ cups of shortening.

6. An envelope is 4″ wide and 5″ long. The width is __?__ of the length.

7. The length (Ex. 6) is __?__ times the width.

8. The ratio of the width to the length (Ex. 6) is __?__ to __?__.

9. The ratio of the length to the width (Ex. 6) is __?__ to __?__.

10. Fred can walk $1\frac{1}{2}$ times as fast as Tom.

The ratio of Fred's rate to Tom's rate is __?__. When Fred walks 12 miles, Tom can go __?__ miles.

Test 4b

1. Mr. Burton sells a mixture of lawn seed that is 2 pounds of clover to 25 pounds of grass seed. How many pounds of clover seed should he mix with 100 pounds of grass seed?

2. Tom has $1.00 to spend for fruit for a picnic. He sees apples marked, "3 for 20¢." How many of these apples can he buy for a dollar?

3. In one seventh-grade class only 4 out of the 36 students could swim.

What part of the total number of students could swim?

4. The ratio of swimmers to non-swimmers (Ex. 3) was ____ to __?__.

5. To make punch, Joe uses 3 cups of water to 2 cups of fruit juice. The juice is what part of the punch?

6. For 100 cups of punch (Ex. 5), Joe uses __?__ cups of fruit juice.

7. If the ratio of a to b is $\frac{3}{4}$, the ratio of b to a is __?__.

8. The ratio of $20 to $40 is __?__; the ratio of $40 to $20 is __?__.

9. If one line is $\frac{3}{4}$ as long as another, the ratio of the first to the second is __?__ to __?__.

10. The ratio $\frac{2}{3}$ equals the ratio $\frac{4}{?}$.

UNIT 11

Per cent of a number
Estimating per cent
100 per cent

Comparing scores by using hundredths

1. Ted belongs to the Rangers basketball team. He likes to practice shooting balls into the basket.

In 25 trials he shot the ball into the basket 10 times. At that rate, in 100 trials he should get the ball into the basket ___?___ times. Think:

▶ $\frac{10}{25} = \frac{?}{100}$

▶ A score of 10 out of 25 is the same as a score of 40 out of 100.

▶ Written as a decimal, Ted's score was ___?___.

2. Dan practices "shooting baskets," too. In 20 trials he got 9 baskets. At that rate, in 100 trials he should get ___?___ baskets. Think:

▶ $\frac{9}{20} = \frac{?}{100}$

▶ 9 out of 20 is the same as ___?___ out of 100.

▶ What decimal represents Dan's score?

3. Use Exs. 1–2 to help you tell which is the better score:

10 baskets out of 25 trials, or
9 baskets out of 20 trials

4. In 10 trials, Joe shot 6 baskets. At that rate, in 100 trials he would get ___?___ baskets.

5. Which one of the three boys, Ted, Dan, or Joe (Exs. 1–4), had the best score?

A good way to compare fractions is to change them to hundredths.

6. A score of 13 baskets out of 20 trials is the same as a score of ___?___ baskets out of 100 trials. ($\frac{13}{20} = \frac{?}{100}$)

What is the score written as a decimal?

7. A score of 16 baskets out of 25 trials is the same as a score of ___?___ baskets out of 100 trials. ($\frac{16}{25} = \frac{?}{100}$)

8. When Bill was in sixth grade his best score at shooting baskets was 13 out of 20. In seventh grade his best score was 17 out of 25. Which is the better score?

9. At practice Margaret shot 11 baskets out of 20 trials. If she continued to shoot at the same rate she would shoot ___?___ baskets in 100 trials.

10. 1 out of 4 gives the same score as ___?___ out of 100.

11. 3 out of 10 gives the same score as ___?___ out of 100.

12. Which is the better score, 1 out of 4 or 3 out of 10? (Use your answers to Exs. 10 and 11.)

13. Which is the better score, 2 out of 5 or 6 out of 20?

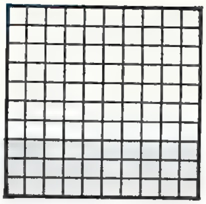
14. Which is the better score, 6 out of 10 or 2 out of 3?

15. Write these fractions in order of size with the smallest first. (Review page 114, if necessary.)

$\frac{1}{2}$ $\frac{3}{8}$ $\frac{1}{4}$ $\frac{2}{5}$ $\frac{3}{4}$ $\frac{1}{3}$ $\frac{3}{5}$ $\frac{2}{3}$ $\frac{1}{8}$ $\frac{4}{5}$ $\frac{5}{8}$

What is per cent?

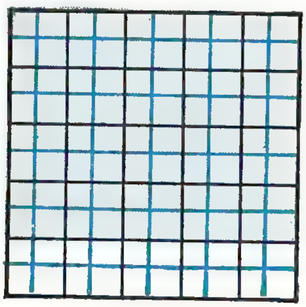
1. In this square there are 100 blocks. How many blocks are colored? We say that 30 out of 100 blocks, or 30 *hundredths* of the square, or 30 ***per cent*** of it is colored.



2. 6 out of 100 = __?__ hundredths = __?__ per cent. 86 out of 100 = __?__ hundredths, or __?__ per cent.

> **Per cent *means* per hundred *or* hundredths.**

3. Ruth spelled correctly 20 out of 25 words. She wanted to know what *per cent* she had spelled correctly.



Ruth drew this square and marked it off into 25 equal blocks. She colored 20 of these blocks to show that she had spelled 20 words correctly.

Ruth next drew blue lines so that she divided the square into 100 small blocks. Ruth saw that:

- 20 out of 25 is the same as 80 out of 100, or 80 hundredths.
- her mark is 80 hundredths or __?__ *per cent.*

4. If Ruth had spelled correctly 23 out of 25 words, what per cent of the words would have been correct?

The symbol for per cent is **%**.

5. Complete these statements:

- 1 out of 2 is the same as 50 out of __?__, or 50 per 100, or __?__%.
- 25 per cent, or __?__%, means 25 per __?__.

25 per 100 is the same as 1 out of 4. $25\% = .25 = \frac{25}{100} = \frac{1}{?}$

- $\frac{3}{4}$ is the same as $\frac{75}{100}$ or .75. So $\frac{3}{4}$ = __?__%.

6. Ray hit the bull's-eye 12 out of 20 times. To find his score as a per cent he wrote:

▶ $\frac{12}{20} = \frac{60}{100} = .60$
▶ .60 = __?__%.

7. Frank hit the bull's-eye 12 times out of 15. This is the way he found his score as a per cent:

▶ He reduced $\frac{12}{15}$ to lowest terms. $\frac{12}{15} = \frac{4}{5}$

▶ Next he changed $\frac{4}{5}$ to hundredths. $\frac{4}{5} = \frac{?}{100}$

▶ He then wrote $\frac{80}{100}$ as a decimal. Show how he did it.

▶ Finally he wrote .80 as __?__%.

8. On a test containing 12 questions, Jane got 9 correct answers. To get her mark on the test as a per cent, Jane wrote:

$\frac{9}{12} = \frac{3}{4} = \frac{75}{100} = .75$ = __?__%.

Changing decimals and fractions to per cents

1. Joe said, "Since *hundredths* and *per cent* mean the same thing, I can write any decimal as a per cent."

He gave these three illustrations:

- $.25 = 25$ hundredths $= 25\%$
- $.12\frac{1}{2} = 12\frac{1}{2}$ hundredths $= 12\frac{1}{2}\%$
- $.08 = 8$ hundredths $= 8\%$

Can you tell how Joe changed the decimals to per cents?

To change a decimal to a per cent, move the decimal point two places to the right and write a per cent sign.

Write as per cents:

	a	*b*	*c*	*d*
2.	.08	.15	.43	.03
3.	$.33\frac{1}{3}$	$.12\frac{1}{2}$	.24	$.87\frac{1}{2}$
4.	.35	.01	$.66\frac{2}{3}$	.40
5.	.09	.17	.25	1.00

Arthur said he knew three ways to change a common fraction to a per cent.

▶ First Way:

$$\frac{1}{2} = \frac{50}{100} = .50 = 50\%$$
$$\frac{3}{4} = \frac{75}{100} = .75 = 75\%$$

6. Tell what was done in changing the fractions $\frac{1}{2}$ and $\frac{3}{4}$ to per cents.

Change the following to per cents:

7. $\frac{1}{2}$ $\quad \frac{1}{4}$ $\quad \frac{1}{5}$ $\quad \frac{1}{10}$ $\quad \frac{7}{10}$

8. $\frac{2}{5}$ $\quad \frac{3}{4}$ $\quad \frac{3}{10}$ $\quad \frac{4}{5}$ $\quad \frac{9}{10}$

▶ Second Way:

$$\frac{9}{15} = \frac{3}{5} = \frac{60}{100} = .60 = 60\%$$
$$\frac{9}{12} = \frac{3}{4} = \frac{75}{100} = .75 = 75\%$$

9. Tell what was done in changing the above fractions to per cents.

Change the following to per cents:

10. $\frac{8}{16}$ $\quad \frac{3}{15}$ $\quad \frac{8}{40}$ $\quad \frac{6}{15}$ $\quad \frac{5}{25}$

11. $\frac{11}{22}$ $\quad \frac{21}{28}$ $\quad \frac{18}{30}$ $\quad \frac{12}{15}$ $\quad \frac{8}{20}$

▶ Third Way:

$$\frac{1}{8} = 1 \div 8 = 8\overline{)1.00} \quad .12\frac{1}{2} = 12\frac{1}{2}\%$$

$$\frac{14}{21} = \frac{2}{3} = 3\overline{)2.00} \quad .66\frac{2}{3} = 66\frac{2}{3}\%$$

12. Tell what was done in changing the fractions $\frac{1}{8}$ and $\frac{14}{21}$ to per cents.

Change the following to per cents:

13. $\frac{6}{16}$ $\quad \frac{4}{12}$ $\quad \frac{5}{8}$ $\quad \frac{7}{8}$ $\quad \frac{7}{15}$

14. $\frac{2}{3}$ $\quad \frac{3}{8}$ $\quad \frac{8}{12}$ $\quad \frac{31}{40}$ $\quad \frac{8}{20}$

To change a common fraction to a per cent, first change the fraction to a decimal; then move the decimal point two places to the right and write a per cent sign.

Change the following to per cents. Use the method that seems the easiest.

15. $\frac{1}{2}$ $\quad \frac{7}{10}$ $\quad \frac{9}{18}$ $\quad \frac{6}{15}$

16. $\frac{5}{15}$ $\quad \frac{14}{40}$ $\quad \frac{7}{8}$ $\quad \frac{5}{20}$

17. $\frac{7}{52}$ $\quad \frac{5}{12}$ $\quad \frac{11}{20}$ $\quad \frac{20}{32}$

Changing per cents to decimals and fractions

1. Fred said, "I know that *per cent* means *hundredths,* so I can change any number with a per cent sign after it to a decimal.

He gave these three illustrations:

- $39\% = 39$ hundredths $= .39$
- $66\frac{2}{3}\% = 66\frac{2}{3}$ hundredths $= .66\frac{2}{3}$
- $2\% = 2$ hundredths $= .02$

Can you tell how Fred changed the per cents to decimals?

> **To change a per cent to a decimal, omit the per cent sign and move the decimal point two places to the left.**

Write the following per cents as decimals:

	a	*b*	*c*	*d*
2.	3%	18%	45%	$87\frac{1}{2}\%$
3.	$33\frac{1}{3}\%$	5%	7%	70%
4.	98%	24%	50%	9%
5.	20%	100%	$2\frac{1}{4}\%$	8%

6. Fred gave these illustrations for changing a per cent to a fraction:

- $25\% = .25 = \frac{25}{100} = \frac{1}{4}$
- $5\% = .05 = \frac{5}{100} = \frac{1}{20}$
- $37\frac{1}{2}\% = .37\frac{1}{2} = .375 = \frac{375}{1000} = \frac{3}{8}$

Can you explain what Fred did in each of the above illustrations?

Change the following per cents to fractions reduced to lowest terms:

	a	*b*	*c*	*d*
7.	25%	50%	75%	10%
8.	20%	30%	40%	60%
9.	80%	$33\frac{1}{3}\%$	$66\frac{2}{3}\%$	$12\frac{1}{2}\%$
10.	$37\frac{1}{2}\%$	$62\frac{1}{2}\%$	$87\frac{1}{2}\%$	$2\frac{1}{4}\%$

11. Most seventh-grade students memorize these equivalents. Do you know all of them?

$50\% = \frac{1}{2}$	$62\frac{1}{2}\% = \frac{5}{8}$	$20\% = \frac{1}{5}$
$25\% = \frac{1}{4}$	$87\frac{1}{2}\% = \frac{7}{8}$	$40\% = \frac{2}{5}$
$75\% = \frac{3}{4}$	$33\frac{1}{3}\% = \frac{1}{3}$	$60\% = \frac{3}{5}$
$12\frac{1}{2}\% = \frac{1}{8}$	$66\frac{2}{3}\% = \frac{2}{3}$	$80\% = \frac{4}{5}$
$37\frac{1}{2}\% = \frac{3}{8}$	$10\% = \frac{1}{10}$	$90\% = \frac{9}{10}$

12. Copy this table and fill in the missing numbers.

FRACTION IN LOWEST TERMS	FRACTION WITH DENOMINATOR 100	DECIMAL	PER CENT
$\frac{1}{2}$	$\frac{50}{100}$	.50	?
$\frac{1}{4}$	$\frac{25}{100}$	?	?
?	$\frac{75}{100}$	?	?
?	?	.40	?
?	?	?	60%
$\frac{1}{5}$	?	?	?
$\frac{1}{10}$	?	?	?
?	?	.80	?
$\frac{1}{20}$	?	.05	?

Thinking about a per cent of a number

1. This whole rectangle is colored. A whole is $\frac{100}{100}$ or 100%.

___?___% of the rectangle is colored.

2. One half of this rectangle is colored. $\frac{1}{2}$ = ___?___%.

___?___% of the rectangle is colored.

3. Only $\frac{4}{10}$ or $\frac{2}{5}$ of this rectangle is colored. Two fifths of the whole rectangle is $\frac{2}{5}$ of 100% = ___?___%.

___?___% of the rectangle is colored.

4. Find 40% of $60 two ways:

▶ First Way:

40% = .40
.40 of $60 = .40 × $60 = ___?___
40% of $60 = $___?___

▶ Second Way:

40% = .40 = $\frac{40}{100}$ = $\frac{2}{5}$
$\frac{2}{5}$ of $60 = $\frac{2}{5}$ × $60 = $___?___
40% of $60 = $___?___

5. Find 20% of $65 two ways:
20% of $65 = .20 × $65 = $___?___
20% of $65 = $\frac{1}{5}$ × $65 = $___?___

6. To find 6% of 600, think:
6% of 600 = .06 × 600 = ___?___

7. About how much is 9% of 240? Think:

9% is a little less than 10%.
10% is $\frac{10}{100}$ or $\frac{1}{10}$. $\frac{1}{10}$ of 240 is ___?___.
So 9% of 240 is a little less than ___?___.

8. Find .09 × 240 and check your answer to Ex. 7.

9. Estimate 77% of 32. Think:

77% is a little more than 75%.
75% is $\frac{3}{4}$. $\frac{3}{4}$ of 32 is ___?___.
So 77% of 32 is a little more than ___?___.

10. Find .77 × 32 and check your answer to Ex. 9.

Choose the answer that you estimate to be correct. Do not compute.

11. 95% of 320 = (31, 162, 304)
Think: 95% is close to 100%.

12. 52% of 450 = (234, 120, 22)
Think: 52% is close to 50%, or $\frac{1}{2}$.

13. 23% of 48 = (46, 11, 15.2)
Think: 23% is close to 25%, or $\frac{1}{4}$.

14. 19% of 350 = (66.5, 6.65, 256)
Think: 19% is close to 20%, or $\frac{1}{5}$.

15. 78% of 95 = (9.6, 52, 74, 88)
Think: 78% is close to 75%, or $\frac{3}{4}$.

16. 81% of 40 = (24, 32.4, 37.4)

17. 48% of 16 = (14, 7.7, 4.8)

Finding a per cent of a number

1. George Jones sold 25 dollars worth of Christmas cards. He was allowed to keep 18% of the \$25. To find how much he earned he thought: 18% of \$25 is .18 × \$25, or __?__. ⟶

$$\begin{array}{r} \$25 \\ .18 \\ \hline 200 \\ 25 \\ \hline \$4.50 \end{array}$$

What will George's earnings be when he has sold 35 dollars worth of cards? 45 dollars worth?

2. Mary Allen sold 24 dollars worth of magazine subscriptions. She was allowed to keep 35% of the \$24. To find how much she earned she thought: 35% of \$24 is .35 × \$24, or __?__. ⟶

$$\begin{array}{r} \$24 \\ .35 \\ \hline 120 \\ 72 \\ \hline \$8.40 \end{array}$$

What will Mary's earnings be when she has sold 28 dollars worth of subscriptions? 34 dollars worth?

"Per cent of" means "hundredths times."

3. 41% of 120 = .41 × 120 = __?__.

4. 54% of 80 = .54 × 80 = __?__.

5. 6% of 750 = .06 × 750 = __?__.

To find a per cent of a number, change the per cent to a decimal and multiply the number by the decimal.

6.	72% of 425	14% of 72
7.	98% of 360	8% of 95
8.	15% of \$25	12% of 340
9.	63% of 200	24% of 75
10.	35% of 600	90% of 64

11. Which of these ways of finding 25% of \$18 do you prefer?

- 25% of \$18 = .25 × \$18 = __?__.
- 25% of \$18 = $\frac{1}{4}$ of \$18 = __?__.

In finding a per cent of a number, it is often convenient to change the per cent to a fraction.

Do Exs. 12–16 mentally; that is, find the per cent of each number by finding a fractional part of the number.

12.	50% of 24	25% of 36
13.	40% of 50	50% of 40
14.	20% of 80	80% of 20
15.	$33\frac{1}{3}$% of 60	$66\frac{2}{3}$% of 21
16.	$12\frac{1}{2}$% of 64	$37\frac{1}{2}$% of 64

17. After you find a per cent of a number, you can often check your answer by estimating to see if the answer is sensible.

Thus in Ex. 1, 18% of \$25 is roughly 20% or $\frac{1}{5}$ of \$25. $\frac{1}{5}$ of \$25 = __?__.

Your estimate shows that \$4.50 is a sensible answer.

After you do each example, check your answer by estimating.

18.	34% of 15	12% of 50
19.	77% of 160	65% of 30

Practice in finding a per cent of a number

1. Which of the two following ways of finding $33\frac{1}{3}\%$ of 240 is the easier?

- Change the per cent to a fraction: $33\frac{1}{3}\%$ of $240 = \frac{1}{3} \times 240 = 80$.
- Change the per cent to a decimal: $33\frac{1}{3}\%$ of $240 = .33\frac{1}{3} \times 240 = 80$.

2. Which of these ways of finding 47% of 382 do you prefer?

- Change the per cent to a fraction: 47% of $382 = \frac{47}{100}$ of $382 = 179.54$.
- Change the per cent to a decimal: 47% of $382 = .47 \times 382 = 179.54$.

Tell whether it is easier to do each example by changing the per cent to a fraction or to a decimal. Then use the easier method.

	a	*b*	*c*	*d*
3.	10% of \$432	25% of 600	18% of 96	40% of 200
4.	$33\frac{1}{3}\%$ of 15	50% of 52.3	5% of 20	8% of 4.32
5.	$12\frac{1}{2}\%$ of 432	52% of 92.4	6% of \$500	35% of 40
6.	$12\frac{1}{2}\%$ of 480	15% of 656	60% of 960	28% of 64.2
7.	$66\frac{2}{3}\%$ of 30	8% of 92	50% of 620	50% of $4\frac{1}{2}$
8.	$87\frac{1}{2}\%$ of 56	3% of \$592	87% of 497	12% of .3456
9.	10% of 56	5% of \$1500	34% of 624	20% of $3\frac{1}{4}$
10.	80% of 200	75% of 960	8% of 625	9% of 16
11.	$37\frac{1}{2}\%$ of 160	15% of 45	11% of 62	16% of 125

12. Fred Jackson bought an automobile that cost \$1560. When he bought it, he had to pay 40% of the cost as a down payment. What was the amount of the down payment?

13. In a city where the sales tax is 2%, what would be the total cost of each of the following articles? (Consider a fraction of a cent as a cent.)

Dress at \$11.98	Scarf at \$ .69
Boots at \$6.49	Gloves at \$2.19

14. Mary Kilty, who works in the dress department at the Forbes and Walker Store, earns \$30 a week plus 5% of her sales.

In a week when her sales are \$600, how much does she earn?

15. At the Forbes and Walker Store, Mrs. Kilty bought a house dress originally marked \$12.00 at a sale advertised "25% off."

The sale price of the dress was __?__.

Discount and commission

1. Dan advertised his bicycle for sale at \$25. He could not sell it at that price. The next week he advertised it for \$20 and sold it.

He reduced the price from \$25 to \$20. The amount of reduction in price is called the **discount.** In this case the discount was \$_?_.

The original price was \$25; the discount was \$5; the **net price** or sale price was \$20.

2. Mr. Ressler bought a television set for \$200 marked down from \$260. What was the original price? the net price? the discount?

3. The employees in the Globe Department Store get an 8% discount on each purchase they make in the store. What would the discount be on a \$75 coat? (Think 8% of \$75 = _?_.) What would the net price be?

The 8% here is called the **rate of discount.**

4. Bill saw an "Atomic Energy Laboratory" marked \$49.50 with a 40% discount. What would the amount of discount be? How much would he have to pay for the set?

5. At a sale where the discount on all goods was 25% Joan bought a denim jacket marked \$3.98. What was the sale price? (In the discount disregard a fraction of a cent.)

\$560

6. Margaret Herbert's father has been offered a new position as a salesman. He is to get \$75 a week and also a *commission* of $12\frac{1}{2}\%$ of the amount of his sales.

That means that if his sales amount to \$400 in a week, he will get $12\frac{1}{2}\%$ of \$400 in addition to the \$75.00.

$12\frac{1}{2}\%$ of \$400 is $\frac{1}{8}$ of \$400 = \$_?_

\$75 + \$50 = \$_?_

He will receive \$_?_.

The \$50 is called a **commission.**

The $12\frac{1}{2}\%$ is the **rate of commission.**

7. The owner of the business told Mr. Herbert that the last salesman who held the position averaged a sale of \$600 worth of goods a week.

If Mr. Herbert could do as well as that he would receive \$_?_ a week.

8. Tell what Mr. Herbert's earnings would be for the weeks in which his sales amounted to each of the following: \$500 \$550 \$700 \$800

9. Mrs. Hunt hired a boy to sell cakes and cookies that she made at home. She paid the boy 10% of the price of each dozen cookies and 15% of the price of each cake.

What was the commission on 12 dozen cookies selling at 50 cents a dozen?

10. What would the commission be (Ex. 9) on 6 cakes at \$1.25 each and 18 dozen cookies at 45¢ a dozen?

15

Estimating a per cent of a number

1. Is 51% of \$80 a little more or a little less than $\frac{1}{2}$ of \$80? Why?

2. Is 9% of \$250 a little more or a little less than $\frac{1}{10}$ of \$250? Why?

3. Is 32% of \$72 a little more or a little less than $\frac{1}{3}$ of \$72? Why?

4. Is 76% of \$20 a little more or a little less than $\frac{3}{4}$ of \$20? Why?

5. Is 67% of 30 a little more or a little less than $\frac{2}{3}$ of 30? Why?

6. Is 29% of 80 nearest to $\frac{1}{4}$, $\frac{1}{3}$, or $\frac{3}{10}$ of 80?

7. Is 71% of 200 nearest to $\frac{2}{3}$, $\frac{3}{4}$, or $\frac{7}{10}$ of 200?

8. Is $.61 \times 150$ nearest to $\frac{1}{2}$, $\frac{3}{5}$, or $\frac{2}{3} \times 150$?

9. Is .88 of 40 nearest to $\frac{3}{4}$, $\frac{7}{8}$, or $\frac{9}{10}$ of 40?

10. Is 26% of 1600 closest to 400, 40, or 420?

11. Is 12% of 800 closest to 100, 108, or 95?

12. Is $\frac{1}{7}$ of 35 nearest to 10%, 15%, or 20% of 35?

Estimate the answers in Exs. 13–18. Check your estimate by finding the exact answers.

	a	*b*
13.	13% of 120	9% of 197
14.	37% of 81	62% of 24
15.	67% of 180	34% of 96
16.	26% of 430	27% of 920
17.	49% of 12	51% of $3\frac{1}{2}$
18.	63% of 48	88% of 160

19. Mary's mother bought a new refrigerator for \$185. She had to pay 18% of this amount as a cash down payment. Estimate her down payment. Check your estimate.

20. Harriet keeps 30% of the money she receives for selling Christmas cards. Last year her total sales amounted to \$24. Estimate how much she kept. Check your estimate.

Explain what these sentences mean:

21. Tom read to the science class, "10% of American farm crops are destroyed by insects each year."

22. Ann read to the social studies class, "The United States produces 97% of the world's grapefruit."

23. Bruce read, "The snowfall in January alone was 35% of all the snow that fell during the winter."

24. An apple is 84% water and 11% sugar. Strawberries are 90% water and 5% sugar.

25. In 20 years the flying time across the United States has been decreased more than 80%.

Problems in per cents

1. The Welfare Club sold book covers to get money for their club work. They started with 250 covers and sold 80% of them the first week. How many were sold that week?

2. The club could keep 8% of the money they received. When they had sold 27 dollars worth of covers, what was their share?

3. John delivers eggs to his father's customers. He keeps 5% of the money he receives for eggs. When eggs are selling for 80 cents a dozen, how much does John get for each dozen he sells?

4. A leather bag was marked \$5.98. When Pat bought it, she found she had to pay a tax of 20% in addition to the \$5.98. What was the amount of the tax? How much did Pat pay in all? (Call a fraction of a cent another cent.)

5. There are 375 students in the seventh and eighth grades. A poster in the corridor stated that 84% of these students had bought tickets for the first football game. How many students had bought tickets?

6. Betty bought 4 yards of cotton material for a dress. The cloth was marked: "Guaranteed not to shrink more than 1%." If it did shrink 1%, how many inches would be left in each yard?

7. Betty made a skirt of this material (see Ex. 6). It is 28 inches long. When it is laundered, it may be 1% of 28 inches shorter. Is it likely to shrink about $\frac{1}{2}$ inch or about $\frac{1}{4}$ inch?

8. John has a model airplane that weighs 16 ounces. The next one he makes will weigh 25% more. How much will it weigh?

9. At a sale, candy was marked "20% off." What was the sale price if the candy originally sold for 60 cents a pound?

10. A small town with a present population of 500 expects a 50% increase in 5 years. What is the expected population 5 years from now?

11. Mr. Hill makes a profit of 10% of the selling price on every pair of shoes he sells. What is his profit on a pair of shoes that sells for \$12.50?

Which of the numbers in each of the following exercises are equivalent?

12.	$\frac{1}{10}$	10%	.10	$\frac{10}{100}$
13.	$\frac{1}{100}$	1%	.01	.10
14.	.05	$\frac{5}{10}$	5%	$\frac{1}{20}$
15.	$\frac{1}{4}$	25%	.25	4%
16.	$\frac{5}{8}$	$\frac{62\frac{1}{2}}{100}$	.625	62.5%
17.	4%	$\frac{4}{10}$	$\frac{4}{100}$	.04
18.	$\frac{3}{8}$	.375	37.5%	$\frac{37\frac{1}{2}}{100}$

One hundred per cent (100%)

You know that 100% means $\frac{100}{100}$ or the whole of anything.

1. A tag on a bolt of woolen cloth reads, "100% wool." What does that mean?

2. A box of white clover seed that Jane bought was marked, "99% pure." That means that __?__% might be weed seeds or chaff.

3. Our flour mills are now using 80% of the wheat kernel to make flour. The rest of the kernel, or __?__% of it, goes into feed for animals.

4. Today about 45% of the people of the United States live on farms. The other __?__% live in towns or cities.

5. Wool and rayon socks are advertised as 50% wool. The socks are __?__% rayon.

6. The school paper reported subscriptions from 100% of the students in the school. If there are 540 students in the school, how many of them subscribed to the paper?

7. When a tree is cut for lumber, only about $33\frac{1}{3}$% of it is useful for lumber. What fractional part of it is not useful for lumber?

8. An easy way to remember that $\frac{1}{4} = 25\%$ is to find $\frac{1}{4}$ of 100%. Explain how to find per cent equivalents of $\frac{3}{4}$, $\frac{1}{3}$, $\frac{3}{5}$, and $\frac{1}{8}$.

9. The Student Council conducted a school fair, at which it made $72. The council voted to give 35% of the money to the Red Cross, 40% to the school library, and the remainder to the neighborhood orphanage. How much money was given to the orphanage?

10. George earned $60 during his summer vacation. He thought, "I'll spend about 30% for clothes, 10% for books; 20% for gifts for my family, and save the remaining __?__ dollars."

11. John bought a secondhand book for 20 cents and saved 75% of the regular price. What per cent of the regular price did John pay?

12. If 32% of the days in one month were cloudy and 17% of the days were rainy, what per cent of the days were neither cloudy nor rainy?

13. A newspaper reported: Only 79% of the quota has been raised. Was that about $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, or $\frac{4}{5}$? What per cent remained to be raised?

14. If a certain mixture of lawn seed is 80% blue grass, 15% red top, and the rest clover, what per cent is clover?

15. In one seventh-grade class, 38% of the boys reported that they drink milk for breakfast. Is this nearer $\frac{1}{3}$ or $\frac{2}{5}$ of the boys? What per cent of the boys do not drink milk for breakfast?

Self-Help Test 5

1. Find the product of 107.85 and 27.6. (98)

2. Express the quotient to the nearest hundredth: $27.5\overline{)38.976}$ (111)

3. Change $\frac{5}{7}$ to a decimal to the nearest hundredth. (114)

4. $4 - 1\frac{3}{4} = \underline{\ ?\ }$ (69)

5. $25 - 23.8 = \underline{\ ?\ }$ (96)

6. $\frac{2}{5} + \frac{3}{4} = \underline{\ ?\ }$ (67)

7. $.25 \times .3 = \underline{\ ?\ }$ (98)

8. $\frac{3}{4} \times \frac{2}{5} = \underline{\ ?\ }$ (75)

9. $\frac{2}{3} \div 2 = \underline{\ ?\ }$ (78)

10. $\frac{1}{8} \div \frac{1}{4} = \underline{\ ?\ }$ (77)

11. $1\frac{3}{4} \times 1\frac{1}{3} = \underline{\ ?\ }$ (76)

12. $27.654 \times 100 = \underline{\ ?\ }$ (101)

13. $23.68 \div 1000 = \underline{\ ?\ }$ (107)

14. $.40 = \frac{?}{5}$ (115)

15. 15% of 56 = $\underline{\ ?\ }$ (145)

16. 100% of 563 = $\underline{\ ?\ }$ (150)

17. $60\% = \frac{?}{5}$ (143)

18. 5 is $\underline{\ ?\ }$ of 20. (126)

Self-Help Test 6

1. 4 cups of juice to $\underline{\ ?\ }$ cups of water is in the ratio of 2 to 3. (132)

2. Write in words the number: 2,070,700,007. (3)

3. Ed can keep 16% of his $250 sales. How much can he keep? (145)

4. A $240 phonograph was sold at 77% of its original price. What was the sale price? (145)

5. A farmer sold a steer that weighed 1000 pounds for $222.50. How much was that per pound? (107)

6. 9 inches is what per cent of a foot? (142)

7. A ticket for the school play cost $.85. How many tickets were sold for a total of $102.85? (104)

8. How long (to the nearest tenth of an hour) did it take a train to go 105 miles at an average speed of 90 miles per hour? (111)

9. At Christmas time Frank sells evergreen wreaths. He can keep 25% of his sales. On sales of $18.60, how much can he keep? (145)

10. Francis had 20 out of 25 examples of an arithmetic test correct. What per cent of the examples were correct? (142)

UNIT 2

Finding what per cent one number is of another
Finding a whole when a per cent is given

What per cent is it?

1. Mary keeps a record of the number of students in her room who buy savings stamps each banking day.

One day 18 out of the 36 students bought stamps. To find what per cent of the students bought stamps, Mary thought:

- ▶ 18 is what part of 36?
- ▶ 18 is $\frac{18}{36}$ of 36
- ▶ $\frac{18}{36} = \frac{1}{2} = \underline{\ ?\ }\%$
- ▶ 18 is 50% of 36

Mary had found what per cent 18 is of 36. She had found *what per cent one number is of another*.

2. On another banking day Mary recorded that 24 out of 36 students had bought stamps. To find what per cent bought stamps, Mary wrote:

- ▶ 24 out of 36 is $\frac{24}{36}$
- ▶ $\frac{24}{36} = \frac{2}{3} = \underline{\ ?\ }\%$
- ▶ 24 is $\underline{\ ?\ }\%$ of 36

3. Can you make a rule to tell how Mary found what per cent one number is of another in Exs. 1–2?

4. 9 is what per cent of 18?

5. 4 is what per cent of 32?

6. After John has gone 1 mile of the two miles he walks to school, what per cent of the total distance has he gone?

7. 3 in. is what per cent of 1 ft.?

8. \$1.50 is what per cent of \$2.00?

9. Today is banking day. Mary (Ex. 1) recorded that only 15 out of 36 students had bought stamps. To find what per cent of the students bought stamps, Mary wrote:

- ▶ 15 out of 36 is $\frac{15}{36}$, or $\frac{5}{12}$
- ▶ $\frac{5}{12} = 5 \div 12 = 12\overline{)5.00}^{\,.41\frac{2}{3}} = \underline{\ ?\ }\%$
- ▶ 15 is $\underline{\ ?\ }\%$ of 36

Mary said, "I didn't know the per cent equivalent of $\frac{5}{12}$, so I divided 5 by 12 to change the fraction to a decimal. Then I changed the decimal to a per cent."

10. Can you make a rule to tell how Mary found what per cent one number is of another in Ex. 9?

> **To find what per cent one number is of another, divide the one number by the other and then express the decimal quotient as a per cent.**

11. Tom made 19 baskets out of 24 trial shots. His score was $\underline{\ ?\ }\%$.

	a	*b*
12.	12 is $\underline{\ ?\ }\%$ of 35	5 is $\underline{\ ?\ }\%$ of 51
13.	27 is $\underline{\ ?\ }\%$ of 46	4 is $\underline{\ ?\ }\%$ of 19
14.	6 is $\underline{\ ?\ }\%$ of 17	2 is $\underline{\ ?\ }\%$ of 17
15.	18 is $\underline{\ ?\ }\%$ of 65	7 is $\underline{\ ?\ }\%$ of 29
16.	9 is $\underline{\ ?\ }\%$ of 71	3 is $\underline{\ ?\ }\%$ of 11

Rate of discount and commission

1. At a special sale Mary bought a 4-dollar sweater for \$3. The original price was __?__; the discount was __?__; and the *rate of discount* was $\frac{\$1}{\$4}$, or __?__%.

The rate of discount was found by comparing the amount of discount with the original price. $\frac{\textit{Discount}}{\textit{Original price}}$, expressed as a per cent, is *rate of discount.*

2. At a sale Tom bought a 30-dollar radio for \$24. What was the rate of discount? $\left(\frac{\$6}{\$30} = \frac{1}{5} = \underline{\ ?\ }\%.\right)$

3. Mr. Smith bought a 600-dollar piano at a sale and paid \$510 for it. What was the rate of discount?

4. When the original price is \$20 and the net price is \$15, the rate of discount is __?__%.

5. When the discount is \$4 and the net price is \$20, the rate of discount is __?__%.

6. Mrs. Allen bought a wool topper for Joan. It was marked \$25.00 but she paid only \$18.75 for it. What was the rate of discount?

7. Bob sold 25 dollars worth of garden seeds. He received a commission of \$10. What per cent of the selling price was his commission?

Compare \$10 with \$25.

$$\frac{\$10}{\$25} = \frac{2}{5} = \underline{\ ?\ }\%.$$

His rate of commission was __?__%.
Check: Does 40% of 25 = \$10?

8. Alice earned a commission of \$6 for selling 24 dollars worth of Christmas cards. To figure her rate of commission she wrote: Rate of commission =

$$\frac{\$6}{\$24} = \frac{1}{4} = \underline{\ ?\ }\%.$$

9. Ted received \$8 for selling 40 dollars worth of magazines. What was his rate of commission?

10. When Dick Brown's father wished to sell a small cottage at the shore, he asked Mr. Baker, the real estate agent to sell the house for \$4000. Mr. Baker sold the house for \$4000 and gave Mr. Brown a check for \$3800. What was the rate of commission?

11. When the selling price of a house is \$15,000 and the commission is \$450, what is the rate of commission?

Estimating per cents

1. Roy, as secretary of the Rocket Club, reports the per cent of the members present at each meeting.

Before he does the actual calculation for the per cent, he makes a mental estimate.

At one meeting when 19 out of the 24 members were present, he estimated this way:

▶ 19 is a little more than 18

▶ $\frac{18}{24} = \frac{3}{4} =$ _?_%

▶ The per cent of the members present is a little more than 75.

2. Estimate the per cent present when 15 of the 24 members are present; when 22 are present; 13; 17.

3. Fred earned \$12 and spent \$6.50. He spent a little more than _?_% of his earnings.

4. A tennis racket is marked, "Regular price, \$12.00. Price today, \$5.98."

The discount is about \$12 minus \$6, or about _?_.

The discount is about _?_% of the regular or original price.

5. When the price of a book is marked down from \$2.98 to \$1.98, the discount is \$_?_. The discount is about _?_% of the original price.

6. A 59-cent fountain pen is marked "$33\frac{1}{3}$% off." This means that about _?_ cents is taken off the regular price.

7. In an archery contest at Millvale School June Ladd established a record by having 114 center hits out of 234 trials.

What fractional part of the number of trials were the center hits? Reduce this fraction to lowest terms. Was the per cent of center hits more or less than 50?

8. 11 is just a little more than _?_% of 40.

9. In June of this year, 22 of the 30 days were sunny. Were about 25%, 50%, 75%, or 90% of the days sunny?

10. Mixed salted nuts marked at \$1.58 per pound were sold at a discount of 40 cents. The rate of discount was about _?_%.

11. When daylight saving began, Mrs. Adams noticed that her electric light bill decreased from \$4.80 in April to \$4.18 in May. Was this a decrease of about 10% or 12%?

Is the first number in each pair about $\frac{1}{2}$, $\frac{1}{3}$, or $\frac{1}{4}$ of the second number?

	a	*b*	*c*	*d*
12.	9, 16	7, 20	7, 27	12, 50
13.	20, 65	19, 42	23, 75	27, 55

Is the first number in each pair about 20%, 40%, or 80% of the second?

14.	7, 42	61, 76	30, 77	24, 64
15.	8, 36	55, 130	60, 80	13, 16

Practice in per cents

Change the following decimals to per cents:

	a	b	c	d	e	f
1.	.09	.27	.85	.02	$.33\frac{1}{3}$	.25
2.	$.37\frac{1}{2}$	.01	$.04\frac{1}{2}$	1.00	.53	.75

Change the following fractions to per cents:

3.	$\frac{3}{4}$	$\frac{1}{2}$	$\frac{1}{8}$	$\frac{3}{8}$	$\frac{1}{10}$	$\frac{3}{10}$
4.	$\frac{7}{10}$	$\frac{7}{8}$	$\frac{3}{20}$	$\frac{7}{20}$	$\frac{1}{3}$	$\frac{2}{3}$

Change the following per cents to decimals:

5.	4%	23%	72%	$37\frac{1}{2}$%	$33\frac{1}{3}$%	6%
6.	98%	50%	5%	100%	10%	20%

Change the following per cents to fractions reduced to lowest terms:

7.	50%	75%	10%	$12\frac{1}{2}$%	25%	20%
8.	$37\frac{1}{2}$%	3%	$33\frac{1}{3}$%	$66\frac{2}{3}$%	60%	90%

Find the per cents as indicated:

	a	b	c	d
9.	50% of 462	40% of 915	80% of 325	$12\frac{1}{2}$% of 968
10.	$33\frac{1}{3}$% of 1024	37% of 962	78% of 165	10% of $234
11.	92% of $800	19% of 731	42% of 300	$66\frac{2}{3}$% of 18
12.	4% of 92	9% of 23.4	$12\frac{1}{2}$% of 648	42% of 85
13.	7% of 592	65% of 784	16% of 942	13% of 75
14.	50% of $7\frac{1}{2}$	25% of $4\frac{1}{4}$	75% of $5\frac{1}{2}$	$33\frac{1}{3}$% of $9\frac{2}{3}$

Find what per cent the first number is of the second:

15.	4, 8	9, 36	6, 18	24, 36
16.	2, 20	43, 860	13, 104	48, 64
17.	19, 95	9.94, 14.2	34, 85	93, 620

Nearest whole per cent

1. The snowfall for one winter was 53 inches. In January, 22 inches of snow fell. Estimate what per cent of the snowfall fell in January. Think:

▶ 22 inches out of 53 inches is $\frac{22}{53}$ of 53 inches.

▶ $\frac{22}{53}$ is about $\frac{20}{50}$, or $\frac{2}{5}$, or _?_%

▶ Approximately 40% of the winter's snowfall fell in January.

2. Compute the answer to Ex. 1 to the nearest whole per cent. Think:

▶ $\frac{22}{53}$ changed to a decimal is the quotient of 22 ÷ 53.

▶ I need to find the quotient of 22 ÷ 53 to the *nearest hundredth* and then change it to a per cent.

$$\begin{array}{r} .415 \\ 53\overline{)22.000} \\ \underline{21\ 2} \\ 800 \\ \underline{530} \\ 2700 \\ \underline{2650} \\ 50 \end{array}$$

▶ As shown in the box, the quotient of 22 ÷ 53 is .415. To the nearest hundredth .415 is .42.

▶ So 22 is 42% of 53 to the nearest whole per cent. Hence _?_% of the total snowfall fell in January.

To find what per cent one number is of another *to the nearest whole per cent*, divide the first number by the second and carry the quotient to thousandths. Round off this decimal to the nearest hundredth and express it as a per cent.

3. Sally is banker in Room 5, which has 32 students in all.

Each banking day she counts the number of students who have deposited money that day.

She next estimates what per cent of the total number of students brought money to deposit.

Then she computes the per cent to the nearest whole per cent.

Copy Sally's table and fill in the blanks to the nearest whole per cent.

DATE	NO. OF STUDENTS IN ROOM 5	NO. WHO BROUGHT MONEY	PER CENT WHO BROUGHT MONEY
Nov. 5	32	19	_?_
Nov. 14	32	23	_?_
Nov. 21	32	24	_?_

4. One year 27 out of the 67 students in the seventh grade had a perfect attendance record. What per cent had perfect records? Give your answer to the nearest whole per cent.

5. Yesterday 3 out of 35 students in one room were absent. What per cent of the students were absent? Give your answer to the nearest whole per cent.

6. 3 days is what per cent of a week (to the nearest whole per cent)?

7. When a necktie priced to sell for $1.98 is sold for $1.50, what is the per cent of discount?

8. Patricia bought 4 pounds of lamb for a roast. When the bone was removed, the roast was found to weigh $1\frac{3}{4}$ pounds.

What per cent of the 4 pounds was bone? Give your answer to the nearest whole per cent.

10¢	**CERTIFICATE**	**10¢**

Present this certificate to your grocer.
It is worth 10¢ toward the purchase of a jar of Creamery Peanut Butter.

9. Sue found the above certificate inside the screen door. She used the certificate as part payment for a 32-cent jar of peanut butter.

What per cent was taken off the regular price? Give your answer to the nearest whole per cent.

In Exs. 10–19, express each answer to the nearest whole per cent:

10. 25 is what per cent of 32?

11. 68 is what per cent of 73?

12. What per cent of 99 is 67?

13. What per cent of 85 is 23?

14. 73 is what per cent of 85?

15. 17 is what per cent of 29?

16. 74 is what per cent of 76?

17. What per cent of 89 is 83?

18. What per cent of 28 is 15?

19. 28 is what per cent of 94?

20. Annette planted a package of morning-glory seeds containing 24 seeds. Only 13 plants came from these seeds.

What per cent of the seeds resulted in plants? Give the answer to the nearest whole per cent.

21. The seed catalogue advertised: 100 bulbs, \$1.65; 500 bulbs, \$7.75. What was Peggy's saving per 100 bulbs if she bought the larger quantity?

To the nearest whole per cent, the saving is what per cent of the advertised price per 100 bulbs?

22. The Lintons' gas bill for this month states: Gross bill, \$4.65; net bill, \$4.43. This means that if the Lintons pay the bill before a given date they can pay the smaller amount.

To the nearest whole per cent, what per cent of discount is offered?

23. In Buckner School 5 out of every 7 students can swim. What per cent of the students, to the nearest whole per cent, can swim?

24. Mary got orders for Girl Scout cookies from 15 out of the 18 people she called on. What fractional part of the people gave her orders? What per cent to the nearest whole per cent?

25. Mrs. Marsh's gas bill read:
Gross bill, \$3.55; net bill, \$3.37.

If Mrs. Marsh paid this bill within 10 days she could pay the smaller amount and not the larger. Give the rate of discount to the nearest whole per cent.

Using per cents to make comparisons

1. The Lakeside School baseball team won 8 out of 11 games. The Glenwood School won 7 out of 10.

To the nearest whole per cent, which team had the higher standing? Think:

▶Lakeside: $\frac{8}{11} = 8 \div 11 =$ _?_ to the nearest hundredth or _?_% to the nearest per cent.

▶Glenwood: $\frac{7}{10} =$ _?_%.

▶The _?_ School had the higher standing.

2. Jack got 7 baskets out of 13 trials. Fred got 9 out of 15. Arnold got 6 out of 11.

What is the per cent score of each boy to the nearest whole per cent? Which boy had the best score?

Compare these records by changing them to the nearest whole per cent:

3. 4 out of 5 with 8 out of 10

4. 4 out of 5 with 13 out of 15

5. 4 out of 5 with 19 out of 26

6. 19 out of 23 with 29 out of 35

7. 2 out of 3 with 3 out of 4

8. 2 out of 3 with 7 out of 11

9. At a sale a 39-cent jar of marmalade was sold for 29 cents and a 59-cent jar of strawberry preserves was sold for 40 cents. How much was the discount in each case? Which was the greater rate of discount?

10. The table below shows the number of persons in Smithtown and the number in Riverdale. It also shows the number of persons treated by a doctor in each town during July.

TOWN	POPULATION	NUMBER TREATED
Smithtown	4700	330
Riverdale	6200	381

What per cent of the population in each town was treated by a doctor?

Which town apparently had the better health record?

11. In one year the soft coal mines produced 446 million tons of soft coal. If 90 million tons were used for heating homes and business buildings, what per cent of all the soft coal was used for these purposes?

(Note that $\frac{90{,}000{,}000}{446{,}000{,}000}$ reduces to $\frac{90}{446}$. Use 90 and 446 instead of the larger numbers.) Give the answer to the nearest whole per cent.

12. What per cent of the soft coal (Ex. 11) was used for other purposes?

13. The science class kept a record of the cloudy days in November and December.

In November there were 5 cloudy days. In December there were 6 cloudy days. Which month had the greater per cent of cloudy days?

Per cent of increase or decrease

1. The price of a quart of milk is increased from 20¢ to 25¢. The original price is 20¢ and the increase in price is 25¢ − 20¢ = 5¢.

- The increase is $\frac{5¢}{20¢}$ or $\frac{1}{4}$ of the original price.
- $\frac{1}{4}$ = .25 = __?__% of the original price.
- $\frac{\text{Increase}}{\text{Original price}}$, expressed as a per cent, is ***per cent of increase.***

2. Albert bought a book for $1.50, and later sold it for $.50. The original price is $1.50 and the decrease in price is $1.50 − $.50 = $1.00.

- The decrease is $\frac{100¢}{150¢}$ or $\frac{2}{3}$ of the original price.
- $\frac{2}{3}$ = .66$\frac{2}{3}$ = __?__% of the original price.
- $\frac{\text{Decrease}}{\text{Original price}}$, expressed as a per cent, is ***per cent of decrease.***

3. A decrease in the price of a dozen oranges from 50¢ to 40¢ is a decrease of __?__%.

4. An increase in pay from 80¢ to 90¢ an hour is an increase of __?__%.

5. The population of a small town increased from 800 to 900 in 5 years. What was the per cent of increase?

6. The population of a larger town increased from 1000 to 1500 in the same time (Ex. 5). Which town had the larger per cent of increase?

7. Mr. Pitt pays 45 cents a dozen for eggs and sells them for 60 cents a dozen. The selling price is an increase of __?__% of the cost.

8. Mr. Shaw's home cost him $5000. Now he can sell it for $10,000. What per cent has it increased in value?

9. When Jim began selling eggs in the winter, he was able to sell 12 dozen a week. Four months later he was selling 19 dozen a week. What is the per cent of increase, to the nearest whole per cent?

10. Mr. Lane's truck was worth $980 last year. This year it is valued at $670. The value of the truck has decreased about __?__%.

11. Make a rule for finding the per cent of increase.

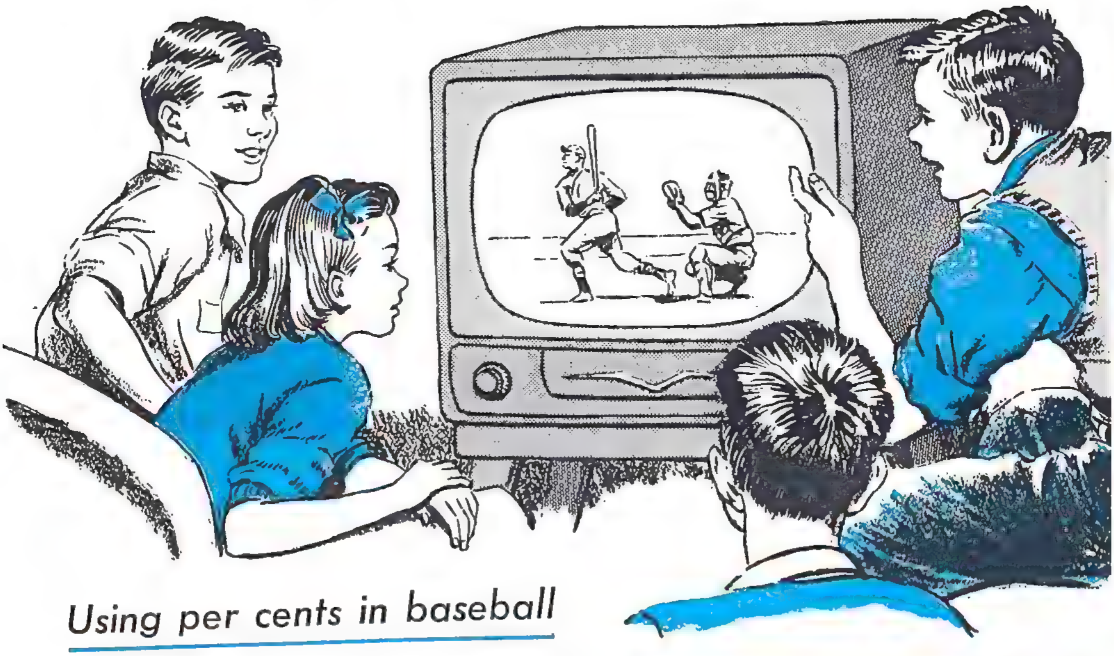
12. Make a rule for finding the per cent of decrease.

13. Use a numerical example to test your rule in Ex. 11.

14. Use a numerical example to test your rule in Ex. 12.

15. Can you state a problem in which the per cent of increase is 100%?

16. Can you state a problem in which the per cent of decrease is 100%?



Using per cents in baseball

Every day during the baseball season records of games won and lost by the teams in the major leagues are printed in the newspapers.

One of the daily records for the National League is shown below.

STANDING OF THE CLUBS

	New York	Milwaukee	Brooklyn	Cincinnati	Philadelphia	Pittsburgh	St. Louis	Chicago	Won	Lost	Percentage
New York	—	3	2	0	3	3	2	2	15	9	.625
Milwaukee	3	—	2	1	5	1	1	1	14	9	.609
Brooklyn	3	1	—	3	2	1	1	1	12	11	.522
Cincinnati	2	1	0	—	1	4	2	2	12	11	.522
Philadel	1	1	4	1	—	1	2	1	11	14	.440
Pittsbgh	0	2	1	3	1	—	2	2	11	14	.440
St. Louis	0	0	1	1	1	2	—	4	9	12	.429
Chicago	0	1	1	2	1	2	2	—	9	13	.409
Lost	9	9	11	11	14	14	12	13	—	—	

1. Read the table horizontally this way: New York (written horizontally) has *won* 3 games from Milwaukee (written vertically), 2 games from Brooklyn, none from Cincinnati, etc.

How many games has New York won from Pittsburgh? from St. Louis? from Chicago?

2. What is the total number of games won by New York? Does this check with the number in the "Won" column of the table? Explain.

3. Read the number of games won by each of the teams from each of the others, and check the "Won" column.

4. Read the columns vertically this way: New York (written vertically) has *lost* 3 games to Milwaukee (written horizontally), 3 games to Brooklyn, 2 to Cincinnati, etc.

How many games has New York lost to Philadelphia? to Pittsburgh? to St. Louis? to Chicago?

5. What is the total number of games lost by New York? Does this check with the number in the "Lost" column of the table?

Note that the number lost can be read both horizontally and vertically.

6. Read the number of games lost by each team to each of the others, and check the "Lost" row.

7. Can you tell from this table how many games each team has played with each of the others? Explain.

8. New York has played 24 games in all. (See "Won" and "Lost" columns.) It has won $\frac{15}{24}$ or $\frac{5}{8}$ of the games. Expressed as a decimal, this is .625.

The team's standing is __?__. It is shown in the "Percentage" column.

Note that the standing of a baseball team is expressed as a decimal *to the nearest thousandth.* If the standing were expressed as is usually done in business, New York's standing would be 62.5% or $62\frac{1}{2}$%, not .625.

9. Check the standings of the teams. Are they correct?

10. What would be the standing of a team that had won 12 games and lost 12 games?

11. What would be the standing of a team that had won 24 games and lost none?

12. The Cleveland team's record for one season was 96 games won, 58 games lost. Its standing was __?__.

13. If Jerry's school team had won 10 games and lost 5, what would be its standing?

14. The batting averages of the players are kept in the records in a similar manner.

When a player has been at bat 8 times and has made 4 hits, his batting average is .500. Explain this.

15. When a player has been at bat 2 times and has made 2 hits, what is his batting average?

16. These are the batting records of five players in a World Series.

	AT BAT	HITS
Doby	22	7
Mitchell	23	4
Robinson	20	6
Torgeson	18	7
Elliot	21	7

Find the batting average of each of the above players. Arrange the averages in order, the highest average first.

17. A batting average of .300 is considered "good." In one season's games a league player made 103 hits out of 345 times at bat. Was his average up to the standard of "good"?

18. At the start of a game Bill Ross had 37 hits out of 110 times at bat. His batting average was __?__.

19. During the game (Ex. 18) Bill was at bat 5 times and had 3 hits. His batting average for that game was __?__.

At the end of the game Bill's batting average for the season was __?__.

Finding the whole when a per cent of it is given

Before working this page, review pages 82–83.

1. John sold magazines for a commission of 30%. To earn \$90, what would John's total sales have to be?

The problem may be solved in two ways:

▶ First Way:

$30\% = \frac{3}{10}$. If $\frac{3}{10}$ of a number is 90, what is $\frac{10}{10}$ of it?

If 3 tenths of the number is 90, 1 tenth of it is $\frac{1}{3}$ of 90, or _?_.

10 tenths of it is 10×30, or _?_.

Check: $\frac{3}{10}$ of \$300 = \$90.

John's total sales must be \$300.

▶ Second Way:

If 30% of a number is 90, what is 100% of it?

If 30% of it is 90, 1% of it is $\frac{1}{30}$ of 90, or _?_.

100% of it is 100×3, or _?_.

Check: 30% of \$300 is \$90.

2. 7% of a number is 14
1% of it is _?_
100% of it is _?_

3. 8% of a number is 24
1% of it is _?_
100% of it is _?_

4. 16% of a number = 64
1% of it = _?_
100% of it = _?_

5. 63% of a number = 315
1% of it = _?_
100% of it = _?_

6. You have just done Exs. 2–5 by the second way. Now do them by the first way, like this:

7 hundredths of a number is 14
1 hundredth of the number is $\frac{14}{7}$ = _?_
100 hundredths of the number is 100×2, or _?_

Do Exercises 7–16 by either method shown above.

7. 20% of _?_ = \$600

8. 50% of _?_ = \$200

9. 70% of _?_ = \$210

10. 25% of _?_ = \$120

11. \$50 = 20% of _?_

12. \$36 = 10% of _?_

13. \$75 = 15% of _?_

14. \$40 = 25% of _?_

15. \$180 = 18% of _?_

16. 40% of _?_ = \$1200

17. A salesman worked on a 20% commission. One month his earnings were \$400. What was the amount of his sales?

18. Jack says the Franklin basketball team won 12 games last season and that these were 60% of the games played. How many games were played?

Finding the regular price Optional

1. John paid \$45 for an overcoat at a sale where there was a 25% discount. What was the regular price of the coat? Think:

▶ Since the discount was 25% of the regular price, the sale price was 75% of the regular price. Why?

▶ The problem becomes: If 75% of a number is 45, what is 100% of it?

▶ 75% of the number = 45

▶ 1% of it = 45 ÷ 75 = .60

▶ 100% of it = 100 × .60 = _?_.

▶ Check: 75% of \$60 = \$_?_.

The regular price was \$60.

2. Fred saw this advertisement: "Sweaters reduced 40%. Now only \$2.40." What was the regular price?

3. A business firm made a profit of \$4600 this year. This was 8% less than last year's profit. What was the profit last year?

4. What were the regular prices of articles bought at the following sale prices and discounts?

	SALE PRICE	DISCOUNT
(*a*)	\$12	20%
(*b*)	\$12	25%
(*c*)	\$17	15%
(*d*)	\$21	30%
(*e*)	\$13.50	10%
(*f*)	\$1.90	5%
(*g*)	\$1.40	$12\frac{1}{2}$%

5. Some of the members of the school band need new instruments. The band leader has posted the sale notice shown in the picture. What is the regular price of each instrument listed?

6. By buying at the sale, how much can a student save on the purchase of a trumpet? a drum? a saxophone? a flute?

Oral work with per cents

	a	*b*	*c*
1.	25% of 40 is ?	10 is ? % of 40	10 is 25% of ?
2.	75% of 60 is ?	45 is ? % of 60	45 is 75% of ?
3.	20% of 45 is ?	9 is ? % of 45	9 is 20% of ?
4.	30% of 80 is ?	24 is ? % of 80	24 is 30% of ?
5.	5% of 200 is ?	10 is ? % of 200	10 is 5% of ?
6.	10% of 120 is ?	12 is ? % of 120	12 is 10% of ?
7.	40% of 1000 is ?	400 is ? % of 1000	400 is 40% of ?
8.	50% of $\frac{3}{4}$ is ?	$\frac{3}{8}$ is ? % of $\frac{3}{4}$	$\frac{3}{8}$ is 50% of ?

9. In which column above are you finding:

- a per cent of a number?
- what per cent one number is of another?
- the whole when a part of it is known?

Tell the missing numbers:

	REGULAR PRICE	RATE OF DISCOUNT	DISCOUNT
10.	$20	10%	?
11.	$10	?	$2
12.	?	40%	$2
13.	$25	20%	?
14.	$45	?	$5
15.	?	10%	$5
16.	$50	20%	?

Tell the missing numbers:

	SALES	RATE OF COMMISSION	COMMISSION
17.	$50	?	$10
18.	?	20%	$10
19.	$200	5%	?
20.	$100	6%	?
21.	?	5%	$40
22.	?	4%	$10
23.	$75	?	$6

24. In which of Exs. 10–23 did you find:

- a per cent of a number?
- what per cent one number is of another?
- the whole when a part of it is known?

Per cent

Group 1

1. What common fraction is equal to each of the following?

50%	75%	$66\frac{2}{3}$%
25%	$33\frac{1}{3}$%	

2. Find 50% of 16. (Use $\frac{1}{2}$ for 50%)

3. Find 25% of 16.

4. Find 75% of 16.

5. Find $33\frac{1}{3}$% of 24.

6. Find $66\frac{2}{3}$% of 24.

7. If John had 75% of 24 examples correct, how many did he have correct?

8. If a suit originally marked $60 is sold at a discount of 25%, how much is the discount? What is the sale price?

9. If I get a commission of 25% for selling Christmas cards, what is the amount of my commission on a sale of $80?

10. Frank's income is 100% more than it was 5 years ago. It was then $50 per week. What is it now?

11. If Springdale's population has decreased $33\frac{1}{3}$% in the last 10 years and 10 years ago it was 3000 people, what is it today?

12. 4 is what per cent of 8?

13. 6 is what per cent of 18?

14. 8 is what per cent of 32?

15. 1% of 235 is __?__.

16. 1% of 63 is __?__.

17. Which is a better score, 3 out of 10 trials, or 4 out of 12 trials? (Think of each of these as a per cent.)

18. Is 19% of a number about $\frac{1}{5}$ of the number or about $\frac{1}{4}$ of the number? Explain.

19. Marjorie said that 51% of 232 is 230. Is that correct?

20. Mr. Jones makes a profit of 25% on goods sold in his store. What is the profit on a suit of clothes selling for $64?

21. The elementary school population in Woodlawn now is 50% more than it was 10 years ago. If it was 2450 then, what is it now?

22. A can of peaches costs 40 cents at the Star Market. If the manager buys the peaches for 30 cents a can, what per cent mark-up does he allow on each can?

Group 2

1. $\frac{4}{20} = \frac{?}{100} = \underline{\ ?\ }\%$

2. If 4 out of 20 squares in a rectangle are shaded, what per cent is shaded?

3. Change the following to per cents:

   .09 .17 $.87\frac{1}{2}$

4. Write the following as per cents:

   $\frac{1}{2}$ $\frac{1}{4}$ $\frac{1}{3}$ $\frac{2}{3}$ $\frac{1}{8}$ $\frac{3}{8}$

5. Write the following as hundredths:

   4% 19% 20% $37\frac{1}{2}\%$

6. Find 68% of 563.

7. Find 39% of 1500.

8. Find $14\frac{1}{2}\%$ of 684.

9. 15 is what per cent of 45?

10. 7 is what per cent of 19 to the nearest whole per cent?

11. When the original price is \$340 and the discount rate is 18%, what is the sale price?

12. If Mary bought for \$4 a sweater marked \$5, what was the rate of discount?

13. Frank received a 20% commission for selling \$80 worth of magazines. What was the amount of his commission?

14. A decrease in the price of oranges from 80 cents a dozen to 60 cents a dozen is a decrease of $\underline{\ ?\ }\%$.

15. An increase in the price of oranges from 60 cents a dozen to 80 cents a dozen is an increase of $\underline{\ ?\ }\%$.

16. Is 60% of 342 nearer $\frac{1}{2}$ of 342 or $\frac{2}{3}$ of 342?

17. A commission agent sold \$5000 worth of goods. His commission was 3%. What was the amount of his commission?

18. Frank Page works in a store where he makes a salary of \$50 a week plus 4% of his sales. If his sales for one week were \$700, would he make \$80? Explain.

19. Westfield has a sales tax of 2% on all purchases. What tax must be paid on a pair of gloves marked \$9.98 plus tax?

20. If the price of an article is \$12 at a 20% discount sale, what is the regular price?

21. If a line 28 inches long is increased by 25% of itself, how long is it then?

22. If 26% of a number is 520, what is the number?

Per cent

▶ Group 3

1. Explain a method of doing each of the following:

a Changing a decimal to a per cent.

b Changing a fraction to a per cent.

c Changing a per cent to a decimal.

d Finding a per cent of a number.

e Finding what per cent one number is of another.

f Finding the sales price when the original price and the rate of discount are known.

g Finding the rate of discount when the original price and the sales price are known.

h Finding the value of a fraction to the nearest whole per cent.

i Finding the per cent of increase when the original value and the increased value are known.

j Finding the regular price when the sales price and the rate of discount are known.

2. Express to the nearest whole number:

21 is what per cent of 32?
4 is _?_% of 13.
What per cent of 30 is 25?
_?_ per cent of 23 is 14.
42 is $87\frac{1}{2}$% of what number?

3. Find the whole when 75% of it is 12.

4. Mr. Dunn has a small grocery store. He allows 15% of the cost of everything he buys for the expenses of running the store. If he buys eggs for 60 cents a dozen, how much would he add to this for the expense of running the store?

5. Mr. Jones bought 100 lb. of clover seed. The analysis on the bag said that it contained only .25% weed seed. Do you think this means $\frac{1}{4}$ or $\frac{1}{4}$ of 1%?

6. Is .25% of 100 lb. equal to 25 lb. or $\frac{1}{4}$ lb.?

7. Which do you believe to be larger, 50% of 16 or .50% of 16?

8. Compare 73% of 90 with 90% of 73.

9. Mrs. Bartlett bought kitchen towels at a sale. If the towels originally cost \$7.20 and Mrs. Bartlett paid \$6.30, what per cent reduction in price did the store allow on the towels?

10. What per cent of 25 is 23.5?

11. How much is 10% of 17% of 413?

12. Is 10 cents more or less than 1% of twenty dollars?

Be your own teacher

Without the help of the teacher, decide whether the following statements are always true, sometimes true, or false. Choose particular numbers to help you decide. Show that your answers are correct.

1. A whole number times a proper fraction is an improper fraction.

2. The sum of two proper fractions is a proper fraction.

3. The difference between two proper fractions is a proper fraction.

4. The sum of two improper fractions is an improper fraction.

5. A whole number times an improper fraction is an improper fraction.

6. A proper fraction divided by a proper fraction is a whole number.

7. A proper fraction divided by a whole number is a proper fraction.

8. If the denominator of a fraction is decreased, the value of the fraction is decreased.

9. If the numerator of a fraction is made larger, the value of the fraction is increased.

10. The quotient of a whole number divided by a mixed number is smaller than 1.

11. If the dividend remains unchanged while the divisor is doubled, then the quotient will be doubled.

12. To write the number 888 in Roman numerals would require a total of thirteen symbols.

13. If the units and hundreds digits in a 3-digit number are interchanged, the number will be smaller.

14. If you multiply $2 \times 3 \times 4$ by 5 your product will be $10 \times 15 \times 20$.

15. $\frac{1}{6}$ is contained in each of the following a whole number of times:

$\frac{1}{3}$ $\quad \frac{1}{2}$ $\quad \frac{5}{6}$ $\quad 1\frac{1}{6}$ $\quad 2\frac{1}{3}$ $\quad 4\frac{2}{3}$

16. The largest common measuring unit of two fractions is the product of their denominators.

17. Any common fraction can be changed to a decimal.

18. Any number between 3.14 and 3.15 is nearer 3.14 than 3.15.

19. A decimal times a whole number is a decimal.

20. The difference between two decimals is a decimal.

21. The quotient of a decimal divided by a decimal is a decimal.

22. The product of two decimals is smaller than either of them.

To the teacher: See Note 10 on page 304.

Holding your ground

Oral review

1. Read these numbers:

.77	.7	.368	3.006
1.025	3.85	12.357	24.0
.02	7.3	7.03	7.003

2. How much is $3 \div 4$? Give your answer as a fraction.

3. If $7 \times 36 = 252$, then you know that $252 \div 36 =$ _?_.

4. Read this number: 25,062,008.

5. Round off .99 to the nearest tenth.

6. Is it possible for 105% of the pupils in your school to be present? Explain.

7. Read these numbers:

MCMXXX XCVIII

8. Fill in the missing numerators:

$\frac{1}{2} = \frac{?}{4}$ $\frac{2}{3} = \frac{?}{6}$ $\frac{2}{2} = \frac{?}{8}$

$\frac{3}{5} = \frac{?}{10}$ $\frac{3}{4} = \frac{?}{12}$ $\frac{7}{8} = \frac{?}{16}$

9. Reduce to lowest terms:

$\frac{12}{16}$ $\frac{10}{15}$ $\frac{16}{64}$ $\frac{20}{50}$ $\frac{16}{36}$

$\frac{50}{75}$ $\frac{15}{50}$ $\frac{60}{80}$ $\frac{35}{55}$ $\frac{24}{48}$

10. $\frac{3}{4} \times \frac{1}{5} =$ _?_ $\frac{1}{4} + \frac{1}{4} =$ _?_

11. $\frac{1}{4} \times \frac{1}{4} =$ _?_ $8 \times \frac{1}{2} =$ _?_

12. $\frac{2}{3}$ of $18 =$ _?_ $\frac{3}{4}$ of $20 =$ _?_

13. $8 \div \frac{1}{2} =$ _?_ $9 \div \frac{1}{3} =$ _?_

14. Is $32.4 \div 4$ equal to .81, 8.1, or 81? Explain.

15. Express each of these decimals as a common fraction reduced to lowest terms:

.50	.25	.75	$.33\frac{1}{3}$	$.66\frac{2}{3}$
.10	.20	.30	.40	.80

16. Express these common fractions as decimals:

$\frac{1}{2}$ $\frac{1}{4}$ $\frac{3}{4}$ $\frac{1}{8}$ $\frac{1}{3}$

$\frac{2}{3}$ $\frac{3}{5}$ $\frac{3}{8}$ $\frac{5}{8}$ $\frac{7}{8}$

In each of the following pairs tell which is the larger:

17. $\frac{3}{5}$ or .65 $\frac{4}{5}$ or $\frac{7}{8}$ $\frac{4}{5}$ or .75

18. $\frac{2}{3}$ or .65 $\frac{1}{8}$ or .10 $\frac{4}{5}$ or .79

19. $\frac{5}{8}$ or $\frac{5}{10}$ $\frac{3}{5}$ or .62 $\frac{1}{3}$ or $\frac{3}{10}$

20. $\frac{5}{8}$ or $\frac{2}{3}$ $\frac{3}{8}$ or $\frac{1}{3}$ $\frac{5}{8}$ or .50

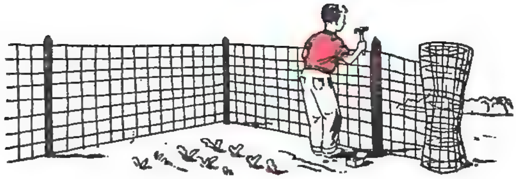
21. Find the sum of 9, 4, 3, 8, 7, 6, and 5.

22. What is the ratio of 8 to 12? 9 to 12? 10 to 12?

23. If alcohol and water are to be used in the ratio 3 to 5 to make an antifreeze solution, how much alcohol should be used to make 16 quarts of the solution?

24. Estimate the cost of $5\frac{3}{4}$ yards of material at \$1.98 a yard.

Holding your ground



Written review

1. Subtract:

a	*b*	*c*	*d*	*e*
4587	4786	904	4000	5008
2846	959	387	2875	2769
1841				

2. Multiply:

4567	40,753	2563	9.24	6.72
29	78	800	50.3	8.09

3. Divide until there is no remainder:

98)9310 58)2030 8)49.84 6.3)20.16 .25)8

4. Subtract 37.648 from 84.72

5. Subtract $3\frac{5}{8}$ from $7\frac{1}{6}$

6. Write in words: 2.035

7. Divide 12 by $\frac{2}{3}$

8. Add: $4\frac{2}{3}$, $5\frac{3}{4}$, and $6\frac{1}{2}$

9. Multiply $3\frac{2}{3}$ by $4\frac{4}{5}$

10. Divide $4\frac{1}{8}$ by $2\frac{3}{4}$

11. Multiply: $168 \times \frac{5}{8}$

12. Find the average of these three numbers: 496, 342, and 695.

13. Change .325 to a common fraction reduced to lowest terms.

14. How much larger is .3 than .003?

15. Divide 27.32 by 26 and give the answer to the nearest thousandth.

16. Change $\frac{3}{13}$ to a decimal expressed to the nearest thousandth.

17. A plane flew 1407 miles in 7 hours. What was its average rate?

18. If a line $\frac{1}{4}''$ long represents 5 miles, how long must a line be to represent $37\frac{1}{2}$ miles?

19. How many $3\frac{1}{4}$-yard lengths can be cut from material 15 yd. long?

20. A recipe for fudge calls for $\frac{2}{3}$ cup of milk. If $2\frac{1}{2}$ times as much fudge as this recipe yields is desired, how much milk should be used?

21. How much milk (Ex. 20) is used for $\frac{1}{2}$ the fudge in the recipe?

Self-Help Test 7

1. $5 \times \frac{1}{6}$ (75)
2. $1\frac{2}{3} \times \frac{4}{5}$ (76)
3. $24 \times 2\frac{1}{2}$ (75)
4. $2\frac{1}{3} \times 17$ (75)
5. $\frac{4}{5} \times \frac{5}{4}$ (75)
6. $5\frac{1}{3} \times 2\frac{1}{4}$ (76)
7. $4 \div \frac{1}{3}$ (77)
8. $\frac{2}{3} \div \frac{2}{3}$ (78)
9. $\frac{3}{4} \div \frac{1}{2}$ (78)
10. $1\frac{2}{3} \div 3$ (78)
11. $8 \div 2\frac{2}{3}$ (78)
12. $9\frac{1}{2} \div 2\frac{1}{3}$ (78)
13. $7\frac{1}{3} - \frac{7}{8}$ (69)
14. $15 - 2\frac{5}{8}$ (69)
15. 87×3.49 (98)
16. $4.63 \times .08$ (98)
17. $\frac{1}{8} + \frac{3}{4} + \frac{2}{3}$ (67)
18. $12\frac{7}{8} + 3\frac{5}{12} + 2\frac{1}{9}$ (68)
19. 50% of 28 (145)
20. 75% of 28 (145)
21. $37\frac{1}{2}$% of 64 (145)
22. 8% of 72 (145)
23. 14% of 68 (145)
24. 100% of 584 (150)
25. $\frac{3}{4}$ of 24 (75)
26. 12 is _?_% of 24 (154)
27. 75 is 25% of _?_ (162)
28. $95.5 \div 7$ (102)
29. $27.58 \div .46$ (104)
30. $426 \div 1000$ (106)

Self-Help Test 8

1. By how much does \$1000 exceed \$475.75? (18)

2. A ratio of 4 to 5 may be expressed as the fraction _?_. (132)

3. What is the ratio of an inch to a foot? (132)

4. Write in words this number: 4,404,040,000. (3)

5. Mary's marks in arithmetic were 90, 85, 100, 90, and 100. What was her average? (112)

6. Express to the nearest thousand: 24,680,982. (8)

7. At 90¢ a pound, $\frac{3}{4}$ lb. of meat will cost _?_¢. (75)

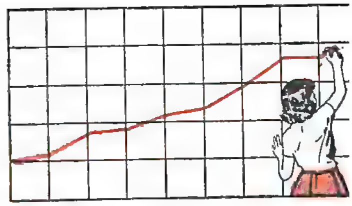
8. Grace has a sheet of paper 10″ wide. How many columns $2\frac{1}{2}$″ wide can she rule on it? (78)

9. At 22.4 cents a gallon, 6 gallons cost _?_. (98)

10. How many pounds of butterfat are there in 46 lb. of milk if 4% of it is butterfat? (145)

11. Mr. Harvey received \$30 and a commission of 10% of his \$500 sales. In all he received _?_. (152)

Measuring your growth in arithmetic



Test 5a

1. The stamp club last Wednesday had 70% of its members present. What per cent was absent?

2. The Springdale Junior High School had 250 tickets to sell for the school play.

At the end of a week 100% of these tickets had been sold. How many tickets were left unsold?

3. 3% of 16 = __?__

4. 43% of $960 = __?__

5. $\frac{15}{30} = \frac{1}{2} =$ __?__%

6. $87\frac{1}{2}\%$ of 240 = __?__

7. 24 is what per cent of 36?

8. 18 is what per cent of 24?

9. Is 27% of 133 more or less than $\frac{1}{3}$ of 133?

10. Flemingtown had 100% more people in 1950 than in 1940. This means that there were __?__ as many people in 1950 as in 1940.

Test 5b

1. 37 is what per cent of 48 to the nearest whole per cent?

2. Ted received $18 for selling $120 worth of merchandise. What was the rate of his commission?

3. A refrigerator is advertised at $244.00 with 12% off if an old refrigerator is turned in. How much is allowed on the old refrigerator?

4. Mr. Hart increased the production of corn on his farm from 165 to 200 bushels an acre. What was the per cent of increase to the nearest whole per cent?

5. 40 is 20% of what number?

6. 24 is 75% of what number?

7. Mr. Clinton sold for $70.00 a desk which he had bought for $48.00.

If he set aside $12 of the $70 for the expenses of his business, how much was clear profit? What per cent of the cost was the profit?

8. A year ago Joe was selling eggs for 60 cents a dozen. Now he gets 75 cents a dozen. The increase in price is __?__% of the former price.

9. If a club has won 7 out of 9 games this season, what is its standing to the nearest thousandth?

10. A bread box is marked down from $1.98 to $1.50. The discount is __?__% of the original price to the nearest per cent.

Margin, overhead, profit

Fred bought a second-hand bicycle for \$15 and spent \$7.50 to have it repaired. He then sold it for \$25.

- The *cost* of Fred's bicycle was \$15.
- The *selling price* was \$25.
- The *margin* was the difference between the selling price and the cost; that is, \$25 − \$15 or \$10.
- The expense of fixing up the bicycle was \$7.50. This is the *overhead expense* or just *overhead*.
- The *profit* was the difference between the margin and the overhead; that is, \$10 − \$7.50 or \$2.50.

1. What do you have to know and do in order to find *margin?* to find *profit?* Illustrate.

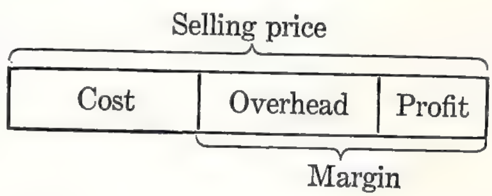
2. Mr. Peters, the grocer, bought 2 dozen cans of corn for \$4.32. How much did each can of corn cost?

3. Mr. Peters sells the corn for 27¢ a can. He sells a can for _?_¢ more than he paid for it. Is this increase margin or profit? Explain.

4. Mr. Peters has many expenses of selling, such as rent, heat, and wages. What are these expenses called?

5. The cost of a can of corn was 18¢. The overhead per can was 5¢. The selling price was 27¢. Find the profit on each can of corn sold.

6. The diagram shows the relation between cost, margin, overhead, profit, and selling price. Explain.



7. Which of these statements are true? Use the diagram to help you.

a. Cost + margin = selling price
b. Selling price − cost = margin
c. Cost + profit = selling price
d. Overhead + profit = margin
e. Margin − overhead = profit

Tell the missing numbers in the following:

	SELLING PRICE	COST	MARGIN	OVERHEAD	PROFIT
8.	\$150	\$100	?	\$20	?
9.	?	\$6	\$3	\$2	\$1
10.	\$25	?	\$8	\$3	?
11.	\$50	\$35	?	\$5	?
12.	\$2	?	\$.50	\$.30	?
13.	?	\$2	\$.60	?	\$.40

Margin, overhead, profit

1. A certain merchant has to *mark up* his goods by 50% of the cost in order to take care of his overhead and profit. What would be his selling price on each of the following articles?

- A can of salmon costing 40 cents.
- One can of soup which he buys by the carton of 24 cans for $1.92.
- A box of crackers bought at the price of 10 boxes for $1.80.
- A bar of soap bought at the rate of 50 bars for $5.00.

2. The owner of the Individual Market can buy a can of Bartlett pears for 20 cents. He charges 30 cents a can for the pears. What is the margin?

3. The overhead expense of the Individual Market (Ex. 2) is figured at 30% of the cost. So the owner adds 30% of the cost of each article to take care of this overhead.

How much is the overhead on a can of pears costing 20 cents?

4. The margin on the can of pears is 10 cents. You have just computed the overhead in Ex. 3. What is the profit?

5. Mr. Winters' overhead expense is about 20% of his cost, so he must *mark up* each article 20% of the cost just to take care of the overhead.

He bought fruit at 25 cents a can. If he sold it for 30 cents a can, would he make a profit? Explain.

6. What is the profit on shoes bought at $4.50 and sold at $6.00, if the overhead is 30% of the cost?

7. Mr. Allen's overhead expense, plus his desired profit, is 50% of his cost. So he must mark up all his goods by 50%. What would be his selling price on an article that cost him 24 cents?

8. What would be the selling price of a box of rice that Mr. Allen (Ex. 7) buys for 12 cents? If 3¢ of Mr. Allen's margin is overhead expense, what is his profit on the rice?

9. The goods Mr. Austin buys cost him about $1500 a month. His overhead expense is about $450 a month. What per cent of the cost is the overhead?

10. Mr. Barnes buys about $1200 worth of hardware a month in his store. He hopes for a profit of $300 a month. This is _?_% of the cost.

11. One week Mr. Wilson bought eggs for 65 cents a dozen and sold them for 85 cents a dozen. His overhead expense was 30% of the cost. Did he make a profit? Explain.

12. A jeweler bought some clocks for $25.00 each and sold them for $32.00. The margin was $_?_. What do you have to know before you can tell whether he made a profit or not?

13. Sweaters which cost \$4.50 were marked to sell for \$5.00. The cost of selling each sweater was 40 cents.

Were these sweaters sold at a profit? How much?

14. A dealer bought some chairs for \$62.00 each. To this \$62 he had to add \$9.00 for overhead.

How much would he have to get for each chair in order to make a profit of 10% of the cost?

15. Mr. Dunn can buy a bat for \$2.00 and sell it at his store for \$4.00. What is the margin?

He has to add 25% to the cost in order to take care of his overhead. What is his profit?

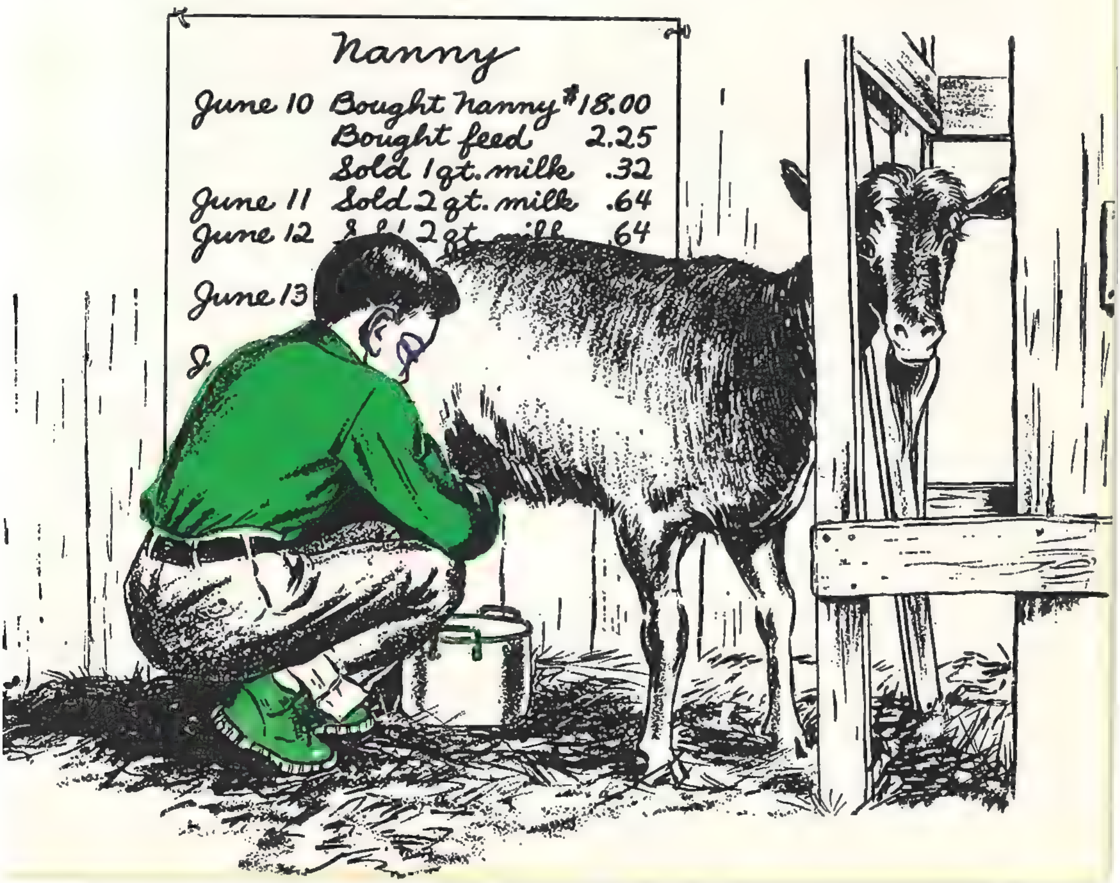
16. Mr. Adams buys sneakers at \$3.00 a pair and sells them at \$4.50 a pair. Mr. Adams figures that he must use $33\frac{1}{3}\%$ of the cost of each article he sells to pay his overhead.

Is he making a profit when he sells these shoes? How much?

17. Fred paid \$18 for a nanny goat. He kept her for 60 days and sold her for \$20.

In the meantime he sold 60 quarts of milk at 32¢ a quart and spent \$7.40 for feed. He worked about $\frac{1}{2}$ hour each day caring for the goat. He figures his time at \$.25 an hour.

In all he paid out _?_ (including the value of his time); he took in _?_; his profit was _?_.



Profit or loss

1. Mr. Miller, a furniture dealer, bought a chair for \$24.00 and sold it for \$38.00. What is the margin?

2. Mr. Miller (Ex. 1) has found that his overhead expense is $33\frac{1}{3}\%$ of his costs.

- How much should he add to the cost of the chair for overhead?
- What is Mr. Miller's profit on the chair?

3. What is the margin when Mr. Miller (Ex. 1) buys a table for \$36 and sells it for \$55?

4. Find the overhead that Mr. Miller allows on the table in Ex. 3. What is his profit on the table?

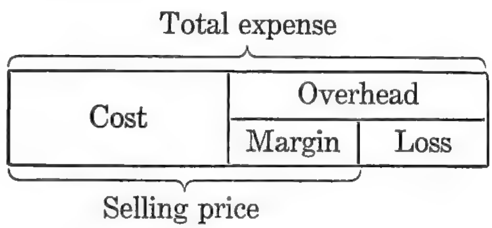
5. A small radio cost Mr. Miller \$33. He sold the radio for \$49. (See Ex. 2.) Find his margin and profit on this sale.

6. The Yarn Shop allows 30% of the cost of an article for overhead. What is the overhead on a cap that costs \$1.00? What is the profit if this cap is sold for \$1.48?

7. Would there be any profit on the cap in Ex. 6 if it is sold for \$1.30? Would there be any loss?

8. A merchant may have to sell goods at a loss because they are perishable. Can you think of other reasons for selling at a loss?

The diagram below shows the relation between cost, margin, overhead, loss, and selling price.



9. When the margin is greater than the overhead there is a profit. When the overhead is greater than the margin there is a __?__.

10. If the overhead is 30% of the cost, what is the overhead on gloves that cost \$2.00 per pair?

What is the margin when these gloves sell for \$2.25? Is there a profit or a loss? How much?

11. Is there a profit or a loss when the gloves (Ex. 10) are sold for \$2.75? How much?

12. Which of these statements are true?

- Profit = selling price − cost − overhead
- Loss = cost − selling price − overhead
- Margin = cost + overhead − loss
- Total expense = cost + margin

13. A washing machine that cost \$160 was sold for \$200. If the overhead was 25% of the cost, was there a profit or a loss? How much?

Per cent of profit and loss

1. The bookstore buys a book for \$1.00 and sells it for \$1.50. The store's average overhead is 30 cents a book.

What is the profit on the book? The profit is what per cent of the cost? ($\frac{20}{100}$ = .20 = __?__%)

2. A pencil that costs 6 cents is sold for 10 cents. If the average overhead is 2 cents a pencil, what is the profit?

What per cent of the cost is the profit? ($\frac{2}{6} = \frac{1}{3}$ = __?__%)

3. Bill bought a boat for \$5.00. He spent \$2.00 for paint. He scraped and painted the boat to make it look better. Then he sold it for \$8.00.

How much was the overhead? (Disregard the cost of labor.)

How much was the profit? The profit was __?__% of the cost.

4. Mr. Cutler buys a basket of fruit for 40 cents. When he sells a basket of this fruit for 60¢, he figures he makes a profit of 8 cents. His overhead is __?__ cents.

His profit is __?__% of the cost.

5. When Mr. Cutler (Ex. 4) sells a basket for 59¢, his profit is only 7¢. His profit is __?__% of the cost.

6. When Mr. Cutler sells a basket for 50¢, he has a loss of __?__¢, which is __?__% of the cost.

7. A merchant paid \$1.00 for a lawn rake. He estimates his overhead at 20% of the cost.

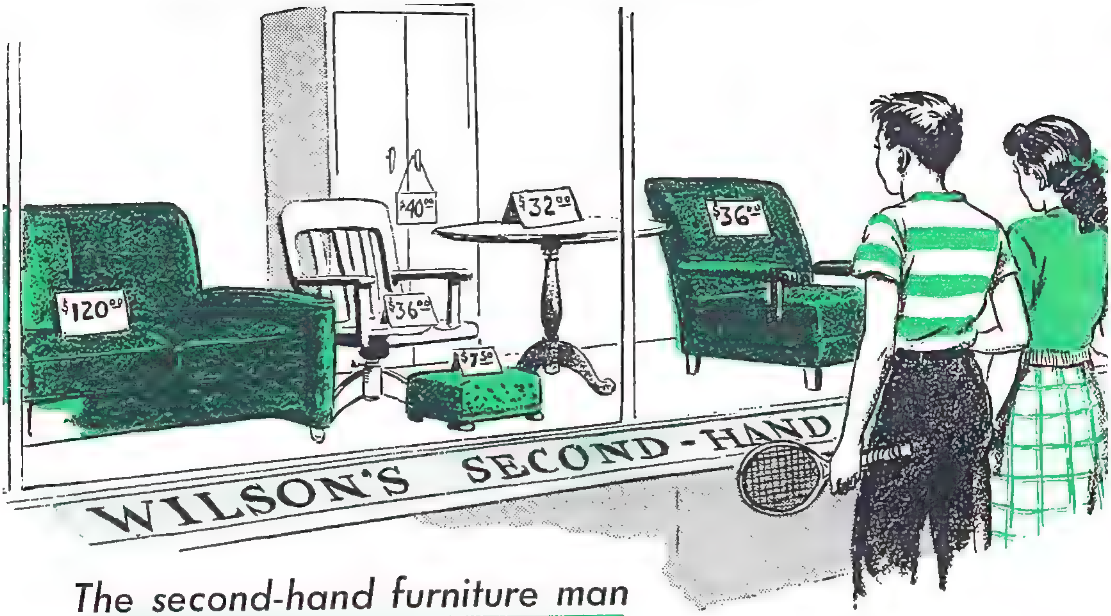
He hoped to sell the rake for \$1.60, giving him a profit of __?__ cents.

8. The merchant (Ex. 7) had to sell the rake for \$1.20.

Did he make a profit or take a loss?

Copy this chart and then fill in the missing numbers:

	COST	PER CENT OF COST IN OVERHEAD	OVERHEAD EXPENSE	COST PLUS OVERHEAD	SELLING PRICE	PROFIT	LOSS	PER CENT OF COST WHICH PROFIT OR LOSS IS
9.	\$40	25%	? \$10	5? 0	\$55	5 ?	0 ? —	?
10.	\$50	30%	?	?	\$60	?	?	?
11.	\$30	20%	?	?	?	\$4	?	?
12.	\$75	?	\$15	?	?	?	\$5	?
13.	\$80	?	\$20	?	\$90	?	?	?
14.	\$15	$33\frac{1}{3}$%	?	?	?	\$3	?	?



The second-hand furniture man

On Saturday morning Joe and Alice went down to visit Mr. Wilson, the second-hand furniture man, in his workshop.

While they were there, Mr. Wilson brought in four pieces of furniture — a day bed, an armchair, a desk chair, and a table. He said, "I just made a good 'buy.' I paid only $120.00 for these four pieces."

When Joe asked Mr. Wilson how much he expected to get for them, he said, "I can't tell yet. That will depend on how much time I spend and how much material I use to put them in good condition.

"I charge at the rate of $4.00 an hour for time spent in fixing furniture for resale."

1. Alice asked him how much he figured he paid for each article.

He said, "Well, I guess it was about $20.00 for each chair and the table. That leaves $\underline{?}$ for the day bed."

Some time later Joe and Alice passed the shop. There sat the furniture in the window all fixed up like new, and each piece was marked with a price tag.

2. They stopped to talk to Mr. Wilson. Joe said, "I notice you are making a profit of $60.00 on the day bed." Was Joe correct?

3. Mr. Wilson said, "Oh, no, I'm not. I spent 6 hours cleaning and polishing that day bed. To pay me for my time at $4 an hour, I have to charge $\underline{?}$ for my labor.

"I used two dollars worth of cleaning fluid, shellac, polish, etc., and besides I figure that I have to charge 20% of the cost of any article to cover the overhead expense.

"That brings the total cost of the day bed up to $\underline{?}$.

"By getting $120.00 for it, I shall be making a profit of $\underline{?}$, and that is $\underline{?}$% of the amount I paid."

4. Mr. Wilson said he had spent 1 hour polishing the table.

If he sold the table for $32.00, he would be making a profit of $__?__, which is __?__% of the cost of the table. (Do not forget the 20% overhead expense. The cost of the polish was negligible.)

5. Mr. Wilson spent 2 hours on each of the chairs. The materials for repairing them cost $2.00 for both.

If he sold the chairs for $36.00 apiece, how much profit would he make on each?

6. He sold the armchair for $36.00. What was his per cent of profit on this chair, figured on the cost?

7. About two months later Joe visited the store and saw the desk chair still standing in the window but marked $34.00.

Can you tell why it had been reduced in price?

8. While Joe was there, a customer came in and bought the desk chair.

What was Mr. Wilson's profit? What was his per cent of profit on the basis of the cost?

9. The table was now marked $30.00. If Mr. Wilson had been able to get $30.00 for it, what would have been his profit?

His profit would have been what per cent of the cost?

10. When Mr. Wilson sold the table, he was able to get only $28.00 for it. What was his profit or loss?

11. What was his total profit on all four pieces of furniture?

12. His total profit was what per cent of the original cost of the furniture?

13. His margin was what per cent of the original cost of the furniture?

14. Using your answer to Ex. 12, what would be your estimate of the amount Mr. Wilson would accept for a four-poster bed if he paid $24.00 for it and expected to spend 8 hours on repairs? (Disregard overhead.)

15. Make a list of all the possible overhead expenses you think a second-hand dealer in furniture would have in operating his shop.

16. In the following statements:

p = the number of dollars of profit;

c = the number of dollars in the cost;

s = the number of dollars in the selling price;

m = the number of dollars in the margin;

o = the number of dollars of overhead.

Which of the statements are true?

- $c + o + p = s$
- $s - p - o = c$
- $p = s - c - o$
- $m = o + p$
- $s - c = m$
- $c + m = s$

Profit as a per cent of the selling price

In business, profit is usually expressed as a per cent of the selling price, not as a per cent of the cost.

1. Joe bought a knife for 80 cents and sold it for $1.00. There was no overhead. His profit was _?_ cents. 20 cents is _?_% of 80 cents. It is _?_% of $1.00. Computed on the basis of the *selling price* his profit was 20%.

2. A school supply store bought 75 dollars worth of notebooks.

The overhead on the merchandise was $15. The notebooks sold for $100.

The profit was $_?_. The profit was _?_ per cent of the selling price.

3. Mr. Starr can buy 100 rulers at 6 cents each. He sells them at 10 cents each and figures a profit of $1\frac{1}{2}$ cents on each ruler.

This is a profit of _?_% of the selling price.

4. An F.M. radio costing $120 is sold for $180. The overhead is $30. The profit is then _?_% of the selling price.

5. A merchant bought a television set for $250. He figures his overhead expense is 40% of the cost. He sold the set for $380.

His profit was what per cent of the selling price? Give your answer to the nearest whole per cent.

Copy this chart and then fill in the missing numbers:

	COST	% OF COST IN OVERHEAD EXPENSE	OVERHEAD EXPENSE	COST PLUS OVERHEAD	SELLING PRICE	PROFIT	% OF SELLING PRICE THAT PROFIT IS
6.	$40	25%	?	?	$60	?	?
7.	$50	20%	?	?	$70	?	?
8.	$75	$33\frac{1}{3}$%	?	?	$125	?	?
9.	$125	20%	?	?	$175	?	?
10.	$150	20%	?	?	?	$20	?
11.	$200	?	$40	?	?	$60	?
12.	$240	?	$40	?	?	$40	?
13.	$300	30%	?	?	$450	?	?
14.	$480	?	$120	?	?	$75	?
15.	$525	?	$105	?	?	$25	?

Sales slips

28 30 140

At the right is shown an *office copy* of a sales slip from the E. F. Green and Company store.

1. On what date was the purchase made?

2. Were the goods sold for cash or were they charged?

Why was it not necessary for the purchaser's name and address to appear on the slip?

3. Check the multiplications and the addition.

4. How much money was handed to the clerk?

5. How much change was due the customer?

6. Explain how you would make change for $4.05 if you were given $4.50.

7. How does the sales slip identify the sales clerk?

E. F. Green & Company

DAYTON, OHIO

CHARGE TO

STREET

CITY AND STATE

DEPT.	CLERK NO.	DATE	HOW SOLD	AMOUNT REC'D	
14	126	6/28	Cash	4	50

6	spools of thread 10¢		60
2	cards buttons 60¢	1	20
1	pr. scissors	2	25
		4	05

PURCHASED BY

SEND TO

STREET

CITY AND STATE

IN CARE OF

DEPT.	CLERK NO.	DATE	HOW SOLD	AMOUNT	

8. Mrs. Miller telephoned an order for food and supplies to be delivered by her grocery store. When the order came, the following items were on the sales slip. Check it.

Scouring powder		15
Bread		21
Vinegar		15
French dressing		39
Lettuce		29
	$1	19

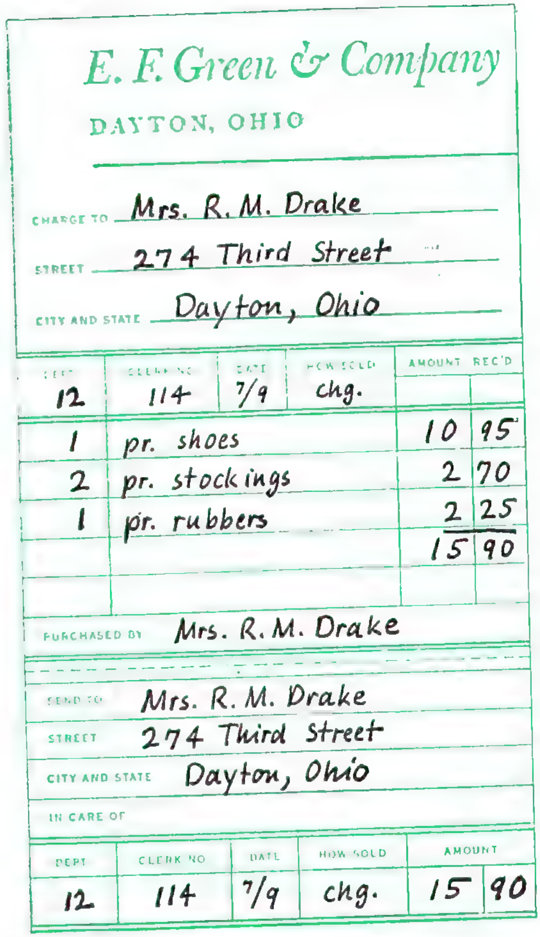
9. Check each item and the total on the following:

2 cream cheese at 19		38
1 doz. oranges		59
mustard		17
2 catsup at 27		54
3 frozen peas at 19		57
4 qt. milk at 23		92
3 lemons		15
syrup		31
	$3	63

Sales slips

1. Does this *customer's slip* show a cash purchase or a "charge"?

2. Before Mrs. Drake signed the slip, she checked each item and the total. Are they correct?



E. F. Green & Company

DAYTON, OHIO

CHARGE TO Mrs. R. M. Drake

STREET 274 Third Street

CITY AND STATE Dayton, Ohio

DEPT.	CLERK NO.	DATE	HOW SOLD	AMOUNT REC'D	
12	114	7/9	chg.		

1	pr. shoes	10	95
2	pr. stockings	2	70
1	pr. rubbers	2	25
		15	90

PURCHASED BY Mrs. R. M. Drake

SEND TO Mrs. R. M. Drake

STREET 274 Third Street

CITY AND STATE Dayton, Ohio

IN CARE OF

DEPT.	CLERK NO.	DATE	HOW SOLD	AMOUNT	
12	114	7/9	chg.	15	90

Rule three sales slips like the one shown and then make out the slips for the goods sold in Exs. 3–5. Find the total amount on each slip.

3. Sold for cash in Dept. 8 by clerk No. 78 on July 26:

$1\frac{3}{4}$ yd. silk at	\$3.96
$2\frac{1}{2}$ yd. rayon at	\$1.50
$\frac{1}{2}$ yd. satin at	\$1.98

Amt. received \$12.00

4. Sold for cash in Dept. 9 by clerk No. 87 on July 15:

5 books at	\$2.50
2 boxes stationery at	\$1.30
1 bottle ink	\$ .25

Amt. received \$16.00

5. Sold in Dept. 10 by clerk No. 92 on July 14 and charged to Mrs. R. H. Vogel:

6 kitchen towels at	\$ .29
1 rayon table cloth at	\$2.98
8 napkins at	\$ .25
6 towels at 2 for	\$1.37
4 aprons at	\$1.37
15 yd. oilcloth at	\$1.39
4 pr. curtains at 2 pr. for	\$1.95
4 pr. curtains at 2 pr. for	\$3.25
6 pillow cases at 2 for	\$1.25

6. What is the total cost of these articles?

Three 24″ × 42″ non-skid loop rugs at \$2.94
Four 63″ × 99″ sheets at \$2.09
Four 42″ × 36″ pillow cases at \$.56
8 bath towels at 2 for \$1.00
$5\frac{1}{2}$ yards washable silk shantung at \$2.98 a yard
2 doz. large washcloths at \$2.15 a dozen

Total sales

Find the total amount of each sale. When there is a fraction of a cent, the clerk charges an extra cent.

1. 1 gal. turpentine at \$1.59
10 lb. nails at 8¢
6 hinges at 2 for 35¢
100 sq. ft. wire screening at 38¢
3 doz. screws at 12 for 15¢

2. $3\frac{1}{2}$ yd. velvet at \$4.95
2 pr. stockings at \$1.35
1 tablecloth at \$3.98
18 buttons at 60¢ a doz.
30 bars soap at 15 for \$1.49

3. $2\frac{1}{2}$ doz. towels at 39¢ each
75 $2\frac{3}{4}$ yd. chambray at \$1.39
$3\frac{7}{8}$ yd. gingham at \$1.59
3

4. 1 pr. shoes at \$12.95
25 6 pr. socks at 2 for 79¢
$1\frac{3}{4}$ yd. rawhide at 32¢ 1,39

5. $5\frac{1}{4}$ yd. toweling at 55¢ 15
1 tablecloth at \$11.98
8 napkins at \$12.00 a doz. 6 95

6. $3\frac{7}{8}$ yd. taffeta at \$1.59
2 pr. gloves at \$3.00 13 9
12 yd. ribbon at 15¢

20,95

7. 2 shirts at \$3.58
1 necktie at \$2.59
2 pr. socks at \$.79

8. 2 cans tomato juice at 25¢ a can
1 pkg. pie crust mix at 2 for 39¢
3 cans peas at 2 for 29¢
1 can frozen orange juice at 2 for 29¢

9. The following items were on a monthly milk bill. Find the total amount of the bill.
45 qt. Grade A milk at $26\frac{1}{2}$¢
6 jars ($\frac{1}{2}$ pt.) heavy cream at 35¢
4 jars cottage cheese at 29¢

10. The following items were on Mrs. Kane's monthly department store bill. Find the total amount of her bill.

Food	\$ 2.30	Hat	\$ 5.95
Shoes	\$10.95	Box	\$ 2.98
Polish	\$ .25	Shirts	\$10.95
Towels	\$ 2.36	Tax	\$ .60

11. These items were bought at sales in several stores but paid for in cash by Mrs. Dawson. How much did Mrs. Dawson spend at the sales?
Two 72″ × 108″ sheets at \$2.39
6 window shades at \$2.98
2 foam-rubber pillows at \$4.95

12. These are Mrs. Frame's purchases at the grocery store. Find the total amount of her bill.
6 lb. apples at 2 lb. for 25¢ 137
1 pkg. cranberries at 2 for 29¢
1 bunch celery at 23¢ a bunch
$6\frac{1}{2}$ lb. onions at 3 lb. for 23¢ 3
$4\frac{3}{4}$ lb. squash at 2 lb. for 15¢ 411

13. Find out about charge accounts in your town. How are they obtained? By whom can they be obtained? What are their advantages and disadvantages?

Bills and discounts

SCHOOL SUPPLY COMPANY
BOSTON, MASSACHUSETTS

DATE Aug. 15, 19—

SENT TO: Midland Public Schools
Midland, Michigan

2% discount if paid within 30 days

15 quart bottles ink	at 60¢ per quart	9	00
10 gross pencils	at \$4.20 per gross	42	00
12 blackboard compasses	at \$1.25 each	15	00
		66	00

1. Check the multiplication for each of the items and then check the addition on the above bill.

2. What will be the amount of discount if the bill is paid within 30 days?

3. The bill was paid on Sept. 1. How much was sent to the School Supply Company?

4. Can you think of a reason why a discount is offered if the bill is paid within 30 days?

STEELE HARDWARE COMPANY
TOPEKA, KANSAS

June 1, 19—

SHIPPED TO Mrs. L. Morton

Terms Net 30 days

QUANTITY	DESCRIPTION	UNIT LIST	GROSS & DISC.	NET PRICE
1	Elec. Flatiron	11.95	20%	9.56

5. Mrs. Morton is a clerk in Steele's Hardware Store and the owners allow her a 20% discount on her purchases in the store.

What is the marked or list price of the flatiron?

6. What was the amount of the discount?

7. What is meant by "net price"?

8. Check the net price.

Receipts				Payments			
July				July			
1	Cash on hand	3	60	2	Baseball game	1	00
5	Work in store	5	00	3	Church		20
7	Mowing lawn	1	00	6	Carfare		25
11	Work in store	6	00	9	Haircut		75
14	Weeding garden	1	25	10	Church		20
18	Work in store	6	00	23	Light for bicycle	1	75
25	Work in store	6	00	30	Savings bank	15	00
				31	Balance on hand	9	70
	Total	28	85		Total	28	85
Aug. 1	Cash on hand	9	70				

Keeping accounts

It is helpful to think of a cash account as a record of money put into and taken out of a money box.

When the box is empty, the sum of the amounts that have been taken out must equal the sum of the amounts that have been put in.

For that reason all money put into the box is entered in the Receipts column and all money taken out (including cash on hand, taken out to be counted when balancing the account) is entered in the Payments column.

When the cash on hand that has been counted is put back into the money box, it is considered as money received (received by the box) and is entered in the Receipts column.

Above is Jack's cash account for the month of July.

1. How much did Jack have on hand July 1?

2. How much did he earn during July?

3. Check the total receipts.

4. How much did he spend during July? How much did he save?

5. What per cent of the amount he earned during July did he save?

6. How much did he have on hand at the end of the month?

7. Explain what Jack did to *balance* his account.

8. How much did Jack have to start the month of August?

Practice in keeping accounts

1. Peggy is treasurer of the Girls' Sports Club. She keeps a record of the club dues and the money the club spends.

Rule a sheet of paper like the account on page 185 and write the treasurer's account for May, using the items below:

May 1, cash on hand, \$5.45.
May 3, dues from 6 members, \$3.00.
May 6, lunch for hike, \$1.50.
May 10, dues from 4 members, \$2.00.
May 24, dues from 5 members, \$2.50.
May 28, to Junior Red Cross, \$5.00.
May 29, picnic, \$3.35.

2. On May 31, Peggy (Ex. 1) had \$3.10 in cash. Balance the account for May.

3. Ask the treasurer of your class or the treasurer of one of the school clubs to discuss with you the way the cash account is kept.

4. The following items are taken from the cash account of the treasurer of Room 108:

March 1, on hand, \$5.30.
March 6, material for costumes, \$4.40.
March 10, class dues, \$1.75.
March 12, printing tickets for play, \$.35.
March 18, ticket sale, \$7.75.
March 19, to school fund, \$10.00.

Rule a sheet of paper like the one on page 185 and write these items in the correct place.

5. On March 15, the treasurer (Ex. 4) had on hand \$2.30. On March 20 the treasurer had 5 cents in cash. Did the account balance on these two dates?

6. No more money (Ex. 5) came in or was paid out during the month. Balance the account for the month.

7. Make an account of receipts and expenditures, using the following items:

June 1, cash on hand, \$12.75; notebook, \$.20; mechanical pencil, \$1.00; school show, \$.50.
June 2, haircut, \$.90; carfare, \$.10; tie, \$.75; movies, \$.25.
June 6, for working in garage, \$5.00.
June 7, church, \$.50; cash on hand, \$13.60.

Does the account balance?

8. Grace earned money by baby sitting. Make an account of her receipts and expenditures using the following items:

June 24, on hand, \$4.60; ribbon, \$.15; notebook, \$.15.
June 25, baby sitting, \$1.00; ink, \$.10; carfare, \$.15.
June 26, movies, \$.20; toy, \$.10; gift from father, \$.50 in cash.
June 29, baby sitting, \$1.00; socks, \$.50; repair of shoes, \$1.00.
July 2, fountain pen, \$1.75.
July 3, cash on hand, \$3.00.

Does the account balance?

What do you need to do?

1. Mr. Frank knows the number of miles he drove on a business trip. He also knows the number of gallons of gasoline he used on the trip.

How can he find the average number of miles he drove on one gallon?

2. You know how many 25-cent savings stamps you can buy each week.

How can you find the number of weeks it will take you to buy an $18.75 savings bond?

3. You have kept a careful record of all the expenses for a family trip. You know the number of people who went on the trip.

How can you find the average expense for each person?

4. The girls in a cooking class know the cost of each of the materials hey used for making candy. They know how much they received when hey sold the candy.

How can they find the amount they nade from the sale of the candy?

5. Bill charges 65 cents an hour or mowing lawns.

How does he find the amount to harge for the number of hours he orks on a lawn?

6. Mary has a recipe for cream oup for 6 servings. She wants to ake soup for 4 servings.

How can she find the amount of ch material to use for 4 servings?

7. You know the number of students in your school last year and the number this year.

How can you find the increase or decrease in the number of students?

8. How can you find the per cent of increase or decrease in Ex. 7?

9. You know the number of inches of rain that fell each day in one month.

How can you find the average daily rainfall for that month?

10. Mr. Hyde made a transatlantic telephone call for which the toll was $12 for the first three minutes or less and $2 for each additional minute.

How can he find the charge for a 9-minute talk?

11. A yearly subscription to a monthly magazine is $4.00. It sells in the stores for 50¢ a copy.

How do you find out how much you would save in a year by buying the magazine the cheaper way?

12. A map is to be drawn to the scale 1 inch = 250 miles.

How would you find out how far apart to place two cities if the distance between them is 975 miles?

13. John saw a flash of lightning and heard the thunder caused by it 7 seconds later. Sound travels about 1090 feet per second.

Tell how John could find out how far away the flash was.

A hiking trip

Ten boys in Riverside School have a hiking club. Before they planned their first long hike, a committee reported about trails and expenses. The committee reported:

"We can have a good 5-day hiking trip on the trails at State Park. There are free shelters on the trails for overnight stops. We shall need sleeping bags, cooking kits, and food for 5 days."

The committee estimated the following expenses:

Food for a 5-day hike — about $40.00 for 10 boys.

Round-trip tickets to the park — $1.80 for each boy.

Money for extra expenses — $5.00 for 10 boys.

1. How much money did the club need for this hike? What would be each boy's share of the expenses as budgeted?

2. The boys voted to pay John, the treasurer of the club, $6.50 each. How much would this put into the treasury?

3. At the bottom of the page is John's account of the money received and money spent for two weeks in April.

- How much money was in the treasury on April 1?
- How many boys paid dues on April 8? on April 11? on April 12?
- Was any expense incurred in these two weeks? What was it, and how much was it?
- On April 12, John reported that there was _?_ in the treasury. Was this amount enough for the trip as the boys had budgeted it?

4. Each boy bought for himself a sleeping bag for $5.00, a camp cook kit for $2.75, a flashlight for $1.50, and a first-aid kit for $1.00.

What was the total cost of these items for each boy?

5. The boys believed that this equipment could be used for at least ten hikes.

What would be the average cost of this equipment per hike, if it were used for ten hikes?

19--	Received			19--	Spent		
April 1	Balance brought forward	2	50	April 8	Postage		15
8	Dues (5)	32	50				
11	Dues (3)	19	50				
12	Dues (2)	13	00				

6. The boys hiked for three days and camped for two days. John paid a fee of $3.00 for the use of the camp site, and obtained a receipt.

> April 20 195-
> Received from John Morse
> Three Dollars
> for Camp Site 14
> $3.00 James Tolman, Park Ranger

Does the receipt show who paid $3.00? who received $3.00? who kept the receipt? (Show names.)

What is the purpose of a receipt?

7. At their first meeting after the hike, John made the treasurer's report shown below.

• What is the total amount of money the club had on hand on April 15?

• What is the total amount actually spent from April 17 to April 20?

How much did John have left after the trip?

8. John added $8.70 to what he had spent from April 17 to April 20. The total was __?__. This total amount is the same as the amount he had received. Does this show that his account is correct? Does the account balance?

9. How much money did the club have to start the week of April 29?

10. Frank, the secretary of the club, made this report:

Number of miles hiked on main trail — 25.7

Number of miles hiked on side trails — 4.3 and 5.4

Highest climb — 1370 ft.

• What was the average number of miles per day for the 3 days' hike on the main trail?

• What was the average number of miles per day for the 5-day trip?

11. What was the total expense for each member of the club for this hike? (See Exs. 5 and 7.)

19--	Received			19--	Spent		
April 15	Balance brought forward	67	35	April 17	Food for hike	37	65
				18	10 tickets $1.80	18	00
				20	Fee for camp site	3	00
					Balance on hand	8	70
	Total	67	35		Total	67	35
April 29	Balance brought forward	8	70				

Making estimates

When you are buying goods at the store, you will often want to make an estimate of the cost of your purchases, in order to check the cost that is given you by the clerk. On many other occasions you will find the habit of making approximate estimates a good one.

Estimate the answer in each of the following exercises:

1. What is the cost of 20 yards at 39 cents a yard? (Think: 20 × \$.40 = \$_?_)

2. What is the cost of 8 eggs at 59 cents a dozen? (Think: $\frac{2}{3}$ of 60 cents = _?_ cents)

3. What is the cost of 1 pound of grass seed at 25 pounds for \$19.85? (Think: \$20 ÷ 25 = \$$\frac{4}{5}$, $\frac{4}{5}$ of a dollar is _?_ cents)

4. How many packages of vegetable seeds at 12¢ per package can John get if he has a dollar?

5. What is the cost of 8 two-ounce balls of wool at 29¢ an ounce?

6. What is the total cost of a jumper for \$5.49 and a blouse for \$2.98?

7. A hurricane wind blowing 149 miles an hour is blowing how many miles a minute?

8. How many hours can an airplane fly if its tank holds 45 gallons of gasoline and it uses 9.8 gallons an hour?

9. $4\frac{3}{16} \times 1\frac{7}{8}$ is about _?_.

10. 25.2 × 4.1 is about _?_.

11. 25 × .98 is about _?_.

12. 35 × 2.98 is about _?_.

13. 11 × 79 is about _?_.

14. 21 × 32 is about _?_.

15. 19 × 49 is about _?_.

16. 29 × 31 is about _?_.

17. 201 × \$1.98 is about _?_.

18. 7.96 × .5 is about _?_.

19. 7.96 × 5.1 is about _?_.

20. 79.6 × .9 is about _?_.

21. 6.05 + 8.95 is about _?_.

22. 48 × .09 is about _?_.

23. Candy is sold at 49¢ a pound. 8 pounds will cost about \$_?_.

24. June bought a slicker for \$4.98 and a pair of boots for \$4.49. About how much change should she get from a 10-dollar bill?

25. A bat for \$3.98, a ball for \$2.98, and a catcher's glove for \$5.98 will cost about \$_?_.

Holding your ground

▶Oral review

1. Multiply by 100:

9   9.4   8.23   45.6   .8   .09

2. Express 21,870,400 to the nearest million.

3. Choose the smallest and the largest numbers:

.145   1.45   145   14.5   .0145

4. Divide by 1000:

1.7   643.1   7.92   8   1600

5. If the Forest Park School scored 60 points in a track meet and Hampshire School scored 5 points, the ratio of points scored by the Hampshire School to points scored by the Forest Park School is __?__. (Express as a fraction reduced to lowest terms.)

6. Express as per cents:

.13 $\frac{1}{4}$ .4 $\frac{3}{5}$ $\frac{3}{8}$ 1.00

7. Express as decimals:

6%   20%   2%   100%   13%   1%

8. Find 50% of the following numbers:

8   20   32   486   500   1000

9. Find 25% of the following numbers:

4   8   20   32   488   8.4

10. Find 75% of the following numbers:

4   8   12   16   20   24

11. Find the following:

a	*b*	*c*
20% of 30	$37\frac{1}{2}\%$ of 32	$62\frac{1}{2}\%$ of 72
10% of 34	$33\frac{1}{3}\%$ of 18	$87\frac{1}{2}\%$ of 24
40% of 40	$12\frac{1}{2}\%$ of 72	60% of 32

12. 8 is what per cent of 16?

13. 9 is what per cent of 45?

14. 8 is what per cent of 32?

15. 2 is what per cent of 8?

16. What per cent of 32 is 4?

17. What per cent of 48 is 6?

18. If 50% of a number is 12, what is the number?

19. If $33\frac{1}{3}\%$ of a number is 9, what is the number?

20. If 75% of a number is 15, what is the number?

21. If $66\frac{2}{3}\%$ of a number is 18, what is the number?

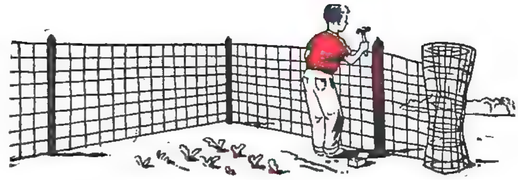
22. Change these decimals to the nearest whole per cents:

.678   .821   .067   .054   .009
.245   .956   .021   .065   .011

23. Explain the difference between margin and profit.

24. How do you compute profit when you know margin and overhead?

Holding your ground



▶ Written review

	a	b	c
1.	324×2.5	32.4×2.5	$3.24 \times .25$
2.	$.059 \times .27$	$\frac{1}{5} \div 2\frac{1}{2}$	$4\frac{1}{3} - 2\frac{3}{5}$
3.	$4\frac{1}{2} \times 1\frac{1}{3}$	$1\frac{1}{2} + \frac{3}{5} + 2\frac{7}{10}$	$9\frac{1}{2} \div 4\frac{3}{4}$

4. Find the average correct to tenths: 80, 90, 100, 92.

5. Express the quotient to the nearest hundredth: $2.87\overline{).16072}$

6. A certain brand of oil is selling for 36 cents a pint, or for 69 cents a quart. If you want a gallon, how much can you save by buying at the quart rate?

7. Write this number in figures: six billion, seventeen million, eleven thousand.

8. 4 gal. 3 qt. + 8 gal. 2 qt. (Express the sum in gallons and quarts.)

9. 8 lb. 6 oz. – 5 lb. 9 oz. (Express the difference in pounds and ounces.)

10. What is the cost of 5200 lb. of hay at \$30 a ton?

11. Find the following:

9% of 120	16% of 23	54% of 530
15% of 84	42% of 96	74% of 324

12. If you are allowed a 5% discount on a bill for \$198.75, how large a check would you send in payment of the bill?

13. If an agent receives a commission of 15%, how much would he receive for making a 2000-dollar sale?

14. \$440 is 22% of what amount?

15. A merchant owes \$9000. He can raise only \$5000 on his property and goods. What per cent of his debts to the nearest whole per cent can he pay?

16. The population of Copperville ten years ago was 141,300. This year the population is reported to have shown a ten-year increase of 54%. What is the population this year?

17. Out of 23 words in spelling, May got 17 right. What per cent of the words did she get right?

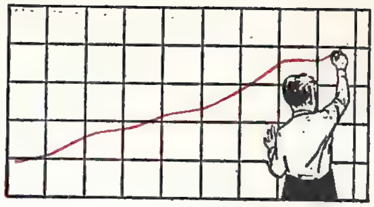
18. A dealer wishes the marked prices of articles he sells to include the cost, a 20% overhead expense, and a profit of 10% of the cost.

How much shall he mark an article which cost him \$4.00?

19. A grocer bought 240 boxes of berries at 20¢ a box. Later he examined 18 boxes and found that 6 of them were not fit to sell.

If the rest of the boxes had spoiled in the same ratio, how much must he get for each box of good berries to make a margin of \$16.00 on the berries?

Measuring your growth in arithmetic



Test 6a

1. What is the total bill for: 5 books at \$2.48, 2 boxes of stationery at \$1.98, and 1 bottle of ink at 15¢?

2. Is 4.12×30.24 nearer to 12, 120, or 1200?

3. If the cost is 30¢, the selling price 50¢, and the overhead 10¢, what is the profit?

4. What is the margin on 12 dozen pencils that cost $2\frac{1}{2}$¢ each and are sold for 5¢?

5. If the overhead (Ex. 4) is $33\frac{1}{3}\%$ of the selling price, the profit is __?__.

6. The profit (Ex. 4) is __?__% of the selling price.

7. Jack started a chicken business in April. His April receipts were \$10.00, \$1.50, \$1.20, \$2.10. His expenditures were \$8.00, \$1.80, \$1.75. How much did he have on May 1?

8. At $62\frac{1}{2}$ cents each, what is the cost of 2 doz. towels?

9. 15 is what per cent of 21?

10. A merchant sold an article that cost him \$6 at a margin of \$2. His margin was __?__% of the selling price.

Test 6b

1. Joe sold 20 glasses of lemonade at 8¢ each. Materials cost 60¢ and a helper 40¢.
What were his total receipts?

2. What was Joe's margin? (Ex. 1)

3. What was Joe's profit?

4. Joe's profit was __?__% of his cost.

5. The Cash Store buys notebook paper at \$14.00 for 100 packages. The selling price of one package is 0 cents. The overhead expense is 0% of the cost of the goods.
What is the profit on one package to the nearest cent?

6. Fruit that cost \$24 is sold for \$32. If the overhead is 25% of the cost, the profit is __?__.

7. At a 20% discount a \$72 coat would sell for __?__.

8. What is the total bill for: $1\frac{3}{4}$ yd. silk at \$7.96, $2\frac{3}{4}$ yd. velvet at \$4.95, $\frac{1}{2}$ yd. satin at \$3.79?

9. When the cost is \$2 and the selling price is \$3, the margin is __?__% of the selling price.

10. The total cost of 2000 pencils at \$3.25 a hundred, 3000 erasers at \$25 a thousand, and 500 notebooks at \$10 a hundred is \$__?__.

Meaning of interest

1. To buy a bicycle for his paper route Bob had to borrow \$50 from his uncle. He agreed to repay the \$50 at the end of a year, and also to pay his uncle 4% of \$50 for the use of the money. 4% of \$50 is \$_?_.

- The \$50 that Bob borrowed from his uncle is called the ***principal***.
- Bob borrowed the \$50 for 1 year. The length of time for which he borrowed the money is called the ***time***.
- The 4% is called the ***rate of interest***, or simply the ***rate***.
- The money Bob pays for the use of the \$50 is called the ***interest***. Bob pays 4% of \$50, or \$2 interest.
- The principal plus the interest is called the ***amount***. At the end of a year Bob will owe \$50 (principal) + \$2 (interest) = \$52 (amount).

2. If Bob could not pay back the \$50 until the end of two years, he would owe 4% of \$50 or \$_?_ interest at the end of the first year and the same interest at the end of the second year. In all, he would have to pay _?_ times as much interest for 2 years as for one year.

3. If Bob could pay back the \$50 in 6 months, the interest would be one half what it would be for a year. $\frac{1}{2}$ of 4% of \$50 = _?_. The interest for 6 months would be \$_?_.

In this case, what is the principal? the rate? the time? the interest? the amount?

4. Charles has \$50 in a savings account. He receives 2% interest each year. 2% of \$50 = \$_?_. How much will his \$50 amount to at the end of 1 yr.? In this case the principal is _?_; the rate is _?_; the time is _?_; the amount is _?_.

Which of the statements in Exs. 5–12 seem sensible? Which do not?

5. The interest on any principal for 6 months is $\frac{1}{2}$ the interest for 1 year.

6. The interest on a dollar for a year at 3% is 3 cents.

7. The interest on \$100 for a year at 3% is 3 dollars.

8. The interest on \$1000 for a year at 3% is \$300.

9. The borrower prefers low interest rates, but the lender prefers high interest rates.

10. The interest on any principal for 8 months is $\frac{2}{3}$ of the interest on that principal for a year.

11. The product of the principal and the rate is the interest for a year.

$$\begin{array}{r} \$400 \\ \times\ .03 \\ \hline \$12.00 \end{array}$$

12. At 3% the interest on \$100 for a year is \$3.00; for a month is 25¢; for $1\frac{1}{2}$ years is \$1.20.

Interest

How much interest will you have to pay on each of the following principals for one year? The first example is done for you. →

$$\begin{array}{r} \$200 \\ .04 \\ \hline \$8.00 \end{array}$$

	a	*b*	*c*
1.	\$200 at 4%	\$300 at 6%	\$65 at 1%
2.	\$500 at 2%	\$675 at 7%	\$43 at 2%
3.	\$450 at 5%	\$300 at 3%	\$96 at 4%

4. The interest on \$200 for 1 yr. at 6% is ___?___.

- For 2 yr. it is twice as much as for 1 yr., or ___?___.
- For 6 mo. ($\frac{1}{2}$ yr.) it is ___?___.
- For 3 mo. ($\frac{1}{4}$ yr.) it is ___?___.
- For 2 mo. ($\frac{1}{6}$ yr.) it is ___?___.
- For 5 yr. it is ___?___.

5. The interest on \$500 for 1 yr. at 4% is ___?___.

- For 2 yr. it is ___?___.
- For 3 yr. it is ___?___.
- For 6 mo. it is ___?___.
- For 4 mo. it is ___?___.
- For 1 mo. ($\frac{1}{12}$ yr.) it is ___?___.

6. The interest you have to pay on borrowed money depends upon the principal, the ___?___ of interest, and the ___?___ you keep the money.

7. If Mr. Townsend lends \$400 for 3 mo. at 6%, how much interest should he get? What amount should he get at the end of the 3 mo.?

8. Can you find any *errors* in the "Interest" or "Amount" columns shown in this table?

PRINCIPAL	RATE	TIME	INTEREST	AMOUNT
\$400	6%	1 yr.	\$24	\$424
\$500	4%	2 yr.	\$ 4	\$504
\$650	3%	6 mo.	\$19.50	\$669.50
\$720	2%	3 yr.	\$43.20	\$763.20
\$840	5%	4 mo.	\$14	\$854

9. Mr. Phillips loaned \$800 at 5% for 6 mo. When the loan was paid, what was the amount?

10. How much will \$850 amount to in $1\frac{1}{2}$ yr. at 4% interest?

11. How much will \$225 amount to in 2 mo. at 6% interest?

12. The Institute for Savings where Ted Manley deposits his money pays interest at 2% a year. But the interest is figured every 6 months, on Jan. 1 and July 1.

If Ted kept \$50 in that bank from Jan. 1 to July 1, how much interest would be added to his money? How much would Ted have in the bank after the interest was added?

13. If you lend \$200 to a friend for 90 days (3 mo.) at 4% interest, how much should he pay you at the end of that time?

Practice in finding interest

▶ Mary wrote the rule for finding interest this way:

interest = *principal* × *rate* × *time*

▶ Bill wrote the rule in this shorthand way:

$$i = p \times r \times t$$

Bill said, "I used the letters i, p, r, and t to stand for numbers. The i stands for the number of dollars in the interest, the p stands for the number of dollars in the principal, the r stands for the rate of interest (decimal or fraction), and the t stands for the number of years in the time."

Bill wrote a *formula*. A ***formula*** is a statement of a rule in which letters represent numbers.

1. To find the interest on \$640 for 9 months at 4%, Mary did the work shown in the box.

```
    $640
     .04
4)$25.60
   $6.40
     × 3
  $19.20
```

● Why did she multiply \$640 by .04?

● Why did she divide \$25.60 by 4?

● Why did she multiply \$6.40 by 3?

2. To find the interest on \$640 for 9 months at 4%, Bill wrote:

$$i = p \times r \times t$$

$$i = \$640 \times \frac{\overset{1}{\cancel{4}}}{100} \times \frac{3}{\underset{1}{\cancel{4}}} = \frac{\$1920}{100} = \$19.20$$

How did he get the $\frac{4}{100}$? the $\frac{3}{4}$?

Find the interest in Exs. 3–22 by whichever method you prefer:

	PRINCIPAL	TIME	RATE
3.	\$800	1 yr.	6%
4.	\$700	6 mo.	4%
5.	\$600	2 yr.	4%
6.	\$500	4 mo.	2%
7.	\$650	6 mo.	4%
8.	\$720	4 mo.	3%
9.	\$490	2 yr.	3%
10.	\$480	$1\frac{1}{2}$ yr.	2%
11.	\$350	2 mo.	6%
12.	\$340	6 mo.	4%
13.	\$280	2 yr.	6%
14.	\$365	3 yr.	4%
15.	\$250	1 yr.	$4\frac{1}{2}$%
16.	\$260	2 yr.	$4\frac{1}{2}$%
17.	\$285	3 yr.	6%
18.	\$395	2 yr.	$5\frac{1}{2}$%
19.	\$364	2 mo.	$4\frac{1}{2}$%
20.	\$175	3 mo.	4%
21.	\$50	$1\frac{1}{2}$ yr.	$6\frac{1}{2}$%
22.	\$70	$2\frac{1}{2}$ yr.	$6\frac{1}{2}$%

Ted and Dick go into business

1. Mr. Miller owned a refreshment stand. He told Ted and Dick Ross that he would give them a job and one-fourth share in his stand if they could "put $500 into the business."

Mr. Ross told his sons that Mr. Miller's refreshment stand was doing a good business and that he would lend the boys $500 at 4% interest. Ted and Dick accepted their father's offer.

At the end of one year the boys would owe their father $_?_.

2. After all costs, wages, and other overhead had been deducted, the stand showed a first year's profit of $120. Ted and Dick received $_?_ as their one-fourth share. This was _?_% of their investment.

3. Ted and Dick paid their father one year's interest on their loan. They paid $_?_ in interest. They still owed $_?_.

4. At the end of the second year the interest was again $_?_. But the boys had made enough to pay their father a total of $130. They still owed $_?_.

5. The next year business was slack and the stand made very little profit. Ted and Dick could afford to pay only the interest on the money they still owed. They paid $_?_ and still owed $_?_.

6. At the end of the following six months business had so improved that the boys paid their father the interest due at that time and one half the remaining principal.

That time they paid their father a total of $_?_.

7. The loan then ran for a year and a half and at the end of that time Ted and Dick paid their father the remaining principal and the interest for $1\frac{1}{2}$ years.

That time they paid back $_?_. How long had the loan run?

8. Ted and Dick borrowed $500. How much did they pay back in all?

9. At the end of five years Ted and Dick had withdrawn $720 from the profits of the refreshment stand, an average of $_?_ a year.

This was _?_% of the amount they had "put up."

10. After Ted and Dick had paid their father in full (see Ex. 8), they had left a total of $_?_, an average of $_?_ for each year.

11. Their average amount left each year (see Ex. 10) was what per cent of their original $500 investment?

12. At the start of the sixth year, Ted and Dick sold their share to Mr. Miller for $600. Their total profit on their 5-year business venture was _?_.

Savings bonds

The United States Government needs billions of dollars for military purposes, salaries, post offices, roads, public buildings, conservation, interest, and many other things.

The government obtains some of the money it needs by selling bonds. Many of us buy United States Savings Bonds. We lend the government money when we buy a bond.

We can buy a bond for \$18.75 and $9\frac{2}{3}$ years later the government will return \$25.00. The difference between \$18.75 and \$25.00 is the interest we get for lending the money.

1. Buying Series E United States Savings Bonds is a good way for a person to save money. A bond for which you pay \$18.75 increases \$6.25 in value in $9\frac{2}{3}$ years. During the $9\frac{2}{3}$ years the increase is __?__% of the cost of the bond.

Later you will learn that these bonds draw compound interest.

2. Find the amount of interest each of these bonds earns in $9\frac{2}{3}$ years:

BOND BOUGHT FOR	RETURNED BY GOVERNMENT AT END OF $9\frac{2}{3}$ YEARS
\$ 18.75	\$ 25.00
37.50	50.00
75.00	100.00
150.00	200.00
375.00	500.00
750.00	1000.00

3. If you saved equal amounts each month, how much would you have to save each month to be able to buy a bond for \$18.75 at the end of the year?

4. Sam has saved \$12.90 of the money that he earned by working Saturdays. How much more does he need to save to buy an \$18.75 bond?

5. Bill's father is buying a \$75.00 bond by having \$6.25 taken from his pay check every four weeks. How many times will \$6.25 be subtracted from his pay? In how many weeks will the bond be paid for?

6. Jane has a Series E bond that is now worth \$25.00. If she loans this \$25.00 to the government for ten years more, her bond will be worth \$33.67. What did she pay for this bond? How much will the bond increase in value in the whole $19\frac{2}{3}$ years?

7. A savings bond bought for \$37.50 will be worth \$50 in $9\frac{2}{3}$ years. What is the per cent of increase?

8. If an emergency forces a man to "cash in" an \$18.75 bond in $7\frac{1}{2}$ years, he will receive only \$23.00. What is the per cent of increase in that case?

Note to Teacher: The maturity values and dates for government bonds have been changed several times. Perhaps the students would like to check the current rates.

Bring check with due.

Problems on savings

1. Ned buys postal savings stamps regularly. Each stamp costs 10¢. If he buys 5 stamps a week for 52 weeks, how much does he save in this way in one year?

2. When Ned has 10 postal savings stamps, he exchanges the 10 stamps for a Postal Savings Certificate. A Postal Savings Certificate has the same value as the 10 stamps, or $\underline{\ ?\ }$.

3. Ned receives 2% interest when he has owned one of these certificates for a year. 2% interest means $\underline{\ ?\ }$ cents on $2; $\underline{\ ?\ }$ cents on $5.

4. If Bill owns 5 of these certificates, the interest he will receive at the end of a year will be $\underline{\ ?\ }$. In 3 years the interest would be $\underline{\ ?\ }$.

5. George Young uses part of what he earns to buy a 20-dollar Postal Savings Certificate every 2 weeks. He will receive $\underline{\ ?\ }$ interest for each certificate he holds for one year.

6. When Robert was 5 years old, his father bought for him a Series E Savings Bond costing $75.

He bought one of these bonds a year for 5 more years. How much did he pay for the bonds?

7. When Robert (Ex. 6) was 14 years, 8 months old the first bond was worth $\underline{\ ?\ }$. By the time he was 19 years, 8 months old, each of the bonds had become worth $\underline{\ ?\ }$.

8. In this way Robert had $\underline{\ ?\ }$ for his education. What part of this amount had Robert's father paid? What per cent?

9. Sales of United States Savings Bonds reported to the Treasury in one year totaled $6,694,194,000. During that year the government paid back $5,125,727,000 to those who wished to "cash in" their bonds and to those who had held them for $9\frac{2}{3}$ years.

How much more was taken in than was paid out?

10. Tom Freeman buys savings stamps at the Post Office for 10 cents each. When he gets 10 stamps, he can exchange them for a Savings Certificate.

He will get 2% interest on the certificate. What is the interest on $1 at 2% for 1 year?

11. What does this mean? "If held for $9\frac{2}{3}$ years, each E Bond will earn 1 dollar for every 3 dollars invested." 4 125

12. What is the original cost of a Series E Bond which will return $500 $9\frac{2}{3}$ years from the date of purchase?

13. How much would you pay for a Series E Bond that after $9\frac{2}{3}$ years would return you $50?

14. In Room 136, 100% of the pupils had purchased stamps during October. What does that mean?

Savings in banks

1. How much interest would you get on $1 if you left it in the above savings bank for 6 months? Assume you put the $1 in the bank on Dec. 31, and left it until July 1. (2% semi-annually means 1% every 6 months.)

2. How much would you have in the bank if you left $1 for 1 year?

3. If you left $100 in the savings bank for 6 months, how much could you withdraw at the end of that time?

4. If, instead of withdrawing your money in Ex. 3, you left the original $100 and the 6-months' interest for another 6 months, how much money would you have?

Savings bank account

Frank Manley worked for a florist last summer. At the end of the first month he had saved $34.60. His father advised him to open an account in a savings bank.

At the bank he was given a ***deposit slip*** like the one illustrated and the ***teller*** helped him make it out.

HOUSTON
FIVE CENTS SAVINGS BANK
DEPOSIT

BOOK NO. 4793

NAME Frank Manley

BILLS	34	00
SPECIE		60
CHECKS (ITEMIZE)		
TOTAL	34	60
CASH BACK		
DEPOSIT		

1. Frank had $34.00 in bills and 60 cents in coin. How do these facts show on the deposit slip?

A person who puts money in a savings bank is called a ***depositor.*** Each time he puts money in the bank he makes out a deposit slip.

Frank was given a ***passbook*** in which all deposits and withdrawals are recorded. He was told to bring it with him when he made deposits or withdrawals. Below is shown a part of the first page of the passbook.

2. On Sept. 14, Frank deposited $10.60. Rule a page like the page in the passbook and show how it looked after the deposit. What was his new balance?

3. This bank gives 2% interest per year on its deposits and adds the interest every half year on Jan. 1 and July 1. If Frank should put $50.00 in the bank on Jan. 1, how much interest would he receive on July 1?

4. Do you have a school savings bank? If so, tell how it works. Do many of the students have accounts in regular savings banks?

IN ACCT. WITH **Frank Manley**

	DATE	WITHDRAWAL	DEPOSIT	INTEREST	BALANCE	TELLER
1	SEP 7 '51		34 60		34 60	CP
2						
3						
4						

A checking account

While Frank was starting his savings account, his father went to another bank to make a deposit in his *checking account*.

1. Read the deposit slip. Can you explain all the items?

It is safer to send a check than to send money through the mail because a check can be made payable to a particular person or organization. Also a bank usually requires identification before cashing a check.

2. On Sept. 25, Mr. Manley made out a check for his son Richard who was at college. Note the check and the stub. To whom is the check made out? Who signed the check?

UNION TRUST COMPANY
DEPOSIT TO CREDIT OF
James Manley
HOUSTON, TEXAS Sept. 7 195-

	DOLLARS	CENTS
BILLS	20	
COIN		
CHECK ON		
1 Boston	4	50
2 3rd National	15	40
3		
4		
5		
6		
7		
8		
9		
10		
11		
TOTAL $	39	90

3. The check shown here is an order to the bank to pay Richard ? .

NO. 132 $ 25.00
Sept. 25 195-
TO Richard Manley
FOR Books

	DOLLARS	CENTS
BAL BROT FORD	450	00
AMT DEPOSITED		
TOTAL		
AMT THIS CHECK	25	00
BAL CARD FORD.	425	00

No. 132 HOUSTON, TEXAS Sept. 25 195- 50-58/213

UNION TRUST COMPANY
OF HOUSTON, TEXAS

PAY TO THE ORDER OF Richard Manley $ $25\frac{00}{100}$
Twenty-five and $\frac{00}{100}$ DOLLARS

James Manley

4. Mr. Manley tore off the check and sent it to Richard, but he kept the stub. Can you explain why he kept the stub?

5. What was the balance in Mr. Manley's account before he wrote the check? afterward?

6. When Richard gets the check he has to *endorse* it (sign his name on the back of it) before he can use it. Do you know why?

7. Do you see that the amount of the check is written both in words and in figures? Do you know why?

Using a budget box

Mr. and Mrs. Frank Page budget their weekly income, using a certain per cent of it for each of these items: Rent, Food, Savings, Clothing, Recreation, Other expenses.

Each week they divide the $60.00 income into six parts according to the per cents they agreed upon and put the money into the small boxes shown in the picture.

1. The number on each small box shows the per cent they agreed upon. Copy and complete this table:

Rent	? %	Clothing	? %
Food	? %	Recreation	? %
Savings	? %	Other expenses	10%

2. All 6 boxes together hold ? % of the week's salary.

3. Copy and complete the following table:

Rent	$15.00	Clothing	$?
Food	$?	Recreation	$?
Savings	$?	Other expenses	$?

4. Sometimes Mrs. Page finds it necessary to spend more for food than the amount budgeted. Then she uses some of the money in the "Other expenses" box. This box and the "Food" box together have ? % of $60.00 each week, or $? .

5. How much is put into the "Clothing" box in 3 months? (Use 13 weeks)

6. How much is put into the "Recreation" box in 1 year?

Estimating interest

1. To estimate the interest on \$254 for 1 year at 4%, James thinks:
1% of \$254 is about \$2.50; so the interest on \$254 at 4% is about 4 times \$2.50, or \$_?_.

2. To estimate the interest on \$987.65 for 1 year at 3%, Jane thinks:
The interest at 1% is about \$10; so the interest at 3% is about \$_?_.

Estimate the interest on the following principals for 1 year:

	a	*b*
3.	\$495.75 at 4%	\$304 at 3%
4.	\$896.89 at 4%	\$1198 at 3%
5.	\$1980 at 2%	\$101.75 at 2%
6.	\$98.99 at 5%	\$998.50 at 5%
7.	\$49.90 at 6%	\$499.90 at 6%
8.	\$1.04 at 2%	\$10.40 at 2%

9. To estimate the interest on \$497.59 at 2% for 18 months, Bob thinks:
The interest on \$497.59 for 1 year at 1% is about \$5; for 18 months the interest at 1% is about $1\frac{1}{2} \times \$5$, or _?_; so at 2%, the interest on \$497.59 is about 2 × _?_, or \$_?_.
Can you think of another good way to estimate the interest?

10. Estimate the interest on \$875.47 for 20 months at 3%; for 32 months at 4%.

11. To estimate the interest on \$100 at 4% for 44 days, Jane thought: the interest on \$100 at 4% for a year is \$4.00; for 30 days the interest is $\frac{1}{12}$ of \$4.00 or about 33 cents; 44 days is about $1\frac{1}{2}$ months; so the interest is about $1\frac{1}{2} \times 33$ cents or _?_ cents.

Estimate the interest on \$500 for:

	a	*b*
12.	28 days at 4%	31 days at 5%
13.	61 days at 4%	59 days at 2%
14.	81 days at 2%	91 days at 3%
15.	178 days at 4%	181 days at 2%
16.	271 days at 2%	269 days at 4%
17.	46 days at 4%	44 days at 2%
18.	74 days at 2%	76 days at 3%

19. Estimate the interest on \$450 for 178 days at 4%.

20. For 1 month, you could have the use of \$200 at 6% for \$_?_.

21. Estimate the interest on \$749.85 for 89 days at 4%.

22. How does knowing the answer to Ex. 21 help you to estimate the interest on \$249.85 for 179 days at 4%?

23. The interest on \$182.25 at 2% for a year is about _?_ dollars, or about _?_ a day.

Review of interest

1. Frank Mullins borrowed \$2000 for 2 years at 4%. What was the principal? the rate of interest? the time? How much interest did he have to pay at the end of each year?

2. How do you find *interest* when you know *principal, rate,* and *time?*

3. Write as a decimal: 2%, 3%, $2\frac{1}{2}$%, $2\frac{1}{4}$%, $2\frac{3}{4}$%.

4. What is the interest on \$650 at $4\frac{1}{2}$% for 3 months?

5. What is the interest on \$700 at 4% for 6 months?

6. How much will \$6000 amount to in 2 years at 3% interest?

7. Compare the interest on \$400 at 6% interest for 2 years with the interest on \$400 at 12% for 1 year.

8. Compare the interest on \$400 at 6% interest for 2 years with the interest on \$800 at 6% for 1 year.

9. Does $400 \times .06 \times 2$ equal $400 \times .12$?

10. Does $400 \times .06 \times 2$ equal $800 \times .06$?

11. Does $400 \times .06 \times 2$ equal $800 \times .12 \times 2$?

12. What is the interest each year on a 5-dollar Postal Savings Certificate if the rate of interest is 2%?

13. After a hard windstorm Bruce King's father had to put a new roof on his house.

He borrowed \$450 and had to pay 3% interest on what he owed. Every six months he paid the interest and he also paid back \$150 on the principal.

How long did it take him to pay back what he borrowed? How much did he pay back in all?

14. John Grant is raising chickens on his father's farm. When he started he borrowed \$100 from his father and promised to pay 4% per year on what he owed until he had paid it all back.

At the end of a year, he paid his father \$79. How much did he then owe?

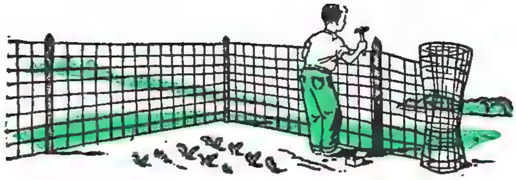
15. What is the interest on \$20 for 40 days at 6%? (Consider a year as 360 days. Then 40 days is what part of a year?)

16. Find the interest on \$900 for 60 days at 4%. (60 days is what part of a year?)

17. What is the interest on \$500 for 30 days at 6%? (30 days is what part of a year?)

18. Find the interest on \$700 for 90 days at 4%. (90 days is what part of a year?)

Holding your ground



Oral review

1. Find $\frac{2}{5}$ of 75.

2. $6 \div \frac{3}{2} = \underline{\ ?\ }$

3. $\frac{1}{10}$ mile is _?_ ft.

4. A 7-foot rope is _?_ yards long.

5. What is the next number in this series? 1.7 1.8 1.9

6. What part of a yard is 2 ft.? What per cent?

7. Read: 3.6 3.06 3.006

8. Does 3.46 have a value between 3 and 4, between 34 and 35, or between 345 and 347?

9. Is $\frac{1}{5}$ more than $\frac{1}{6}$?

10. Is $\frac{4}{4}$ a proper or an improper fraction?

11. If one space on a bar graph represents 2 campers, how many campers are represented by $15\frac{1}{2}$ spaces?

12. Anne has a piece of toweling $2\frac{1}{2}$ yd. long. After she cuts off a $\frac{3}{4}$-yard piece, how much will there be left?

13. How many strips of cloth $\frac{3}{4}$ yard wide can be cut from a piece $1\frac{1}{2}$ yards wide?

14. Give the missing numerators:

$\frac{1}{2} = \frac{?}{16}$ $\frac{3}{4} = \frac{?}{16}$ $\frac{3}{8} = \frac{?}{16}$

15. In a scale drawing 1 inch represents 200 miles. What distance is represented by a line $1\frac{1}{4}$ inches long?

16. What are the missing numbers in each of the following?

$\frac{1}{4}$, $\frac{3}{4}$, $1\frac{1}{4}$, _?_, _?_, $2\frac{3}{4}$, $3\frac{1}{4}$

$\frac{1}{8}$, $\frac{3}{8}$, $\frac{5}{8}$, _?_, _?_, $1\frac{3}{8}$, $1\frac{5}{8}$

$\frac{3}{4}$, $1\frac{1}{2}$, $2\frac{1}{4}$, _?_, _?_, $4\frac{1}{2}$, $5\frac{1}{4}$

$1\frac{1}{2}$, 3, $4\frac{1}{2}$, _?_, _?_, 9, $10\frac{1}{2}$

10, $8\frac{1}{2}$, 7, _?_, _?_, $2\frac{1}{2}$, 1

17. What is 4,856,573 to the nearest thousand?

18. Which is the largest and which is the smallest number here?

.25 25 $\frac{1}{25}$ 2.5 $2\frac{1}{25}$ .025

19. At 3 for 25 cents, what is the cost of 9 apples?

20. Mr. Green estimates that his overhead expense is $33\frac{1}{3}\%$ of the cost of goods handled. If he sells for \$45.00 a table that cost him \$30.00, does he gain or lose? How much?

21. Read this number: MCCCXX

22. If 15% of a class is absent, what per cent is present?

23. In a mixture containing 3 cups of milk and 10 cups of water, what is the ratio of milk to water? of water to milk?

Holding your ground

▶ Written review

1. Add:

$$\begin{array}{r} 7108 \\ 12915 \\ 43086 \\ \underline{8503} \end{array}$$

2. Subtract:

$$\begin{array}{r} 6874 \\ \underline{4000} \end{array}$$

3. Subtract:

$$\begin{array}{r} 6000 \\ \underline{4874} \end{array}$$

4. Multiply:

$$\begin{array}{r} 8169 \\ \underline{68} \end{array}$$

5. Add: $7.32+84.6+9.73+4.929$

6. Multiply 2.34 by 6.2

7. $6.3\overline{)20.412}$

8. Change $\frac{121}{12}$ to a mixed number.

9. Write $4 \div 7$ as a fraction.

10. Divide 263 by 74 and give your answer to the nearest hundredth.

11. Reduce $\frac{18}{48}$ to lowest terms.

12. $60 \times 2003 =$ ___?___

13. Add: $\frac{7}{8} + 9\frac{1}{2} + 5\frac{1}{4}$.

14. Subtract $5\frac{2}{3}$ from $16\frac{1}{4}$.

15. $18.92 \times 10 =$ ___?___

16. $18.92 \times 100 =$ ___?___

17. $18.92 \times 1000 =$ ___?___

18. Mary sold nuts for $1.20 a pound. At that rate, what should she charge for 1 ounce?

19. At $5.40 a gallon for paint, how much should you pay for 3 quarts?

20. Change $\frac{5}{12}$ to a decimal correct to the nearest tenth.

21. Find the following:

42% of 24	62% of 75	12% of $4.20
56% of 82	26% of 263	4% of 225

22. Bob Holmes bought $8.50 worth of books at a discount of 8% for cash. How much did he save by paying cash?

23. It rained 7 of the 30 days in April. What per cent of the days of the month were rainy?

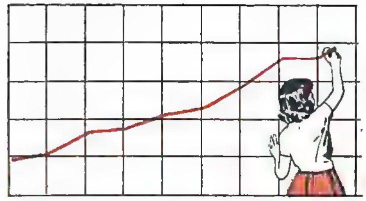
24. Mr. Tilden figures that his overhead is 35% of the original cost. What is his overhead on a can of dog food costing him 6 cents? Give the answer to tenths of a cent.

25. "Sweaters Reduced 40%: Now Only $2.40." What was the regular price?

26. Mr. Evers bought a coat for $52.00. He found that it was not as warm a coat as he needed; so he sold it for $45.00. That was a loss of $___?___ or ___?___% of the cost (to the nearest whole per cent).

27. The 72 members present were 50% of the total membership of ___?___.

Measuring your growth in arithmetic



▶Test 7a

1. Interest = principal × _?_ × _?_ in years.

2. Write as decimals: 6%, 3%, 36%.

3. Frank Perry's father has a balance of $254.62 in his checking account. After writing checks for $62.73, $42.06, and making a deposit of $25.73, what was his new balance?

4. What is the interest on $432 at 5% for 6 months?

5. Amount = principal + _?_.

6. What is the interest on $75 at 4% for 4 mo.?

7. Find the interest on $600 at $5\frac{1}{2}$% for 2 yr.

8. Tom has borrowed $200 from Mr. Green for 2 yr. at $4\frac{1}{2}$% interest. How much interest will he have to pay for the use of the money?

9. In Ex. 8, what is the principal? the rate of interest? the time?

10. What does it mean to *endorse a check?*

▶Test 7b

1. Frank Fisher bought a Series E Bond in 1950 for $18.75. In 1960 that bond will be worth $25.00. The average yearly interest is _?_.

2. If you lend $150 for 3 mo. at 3% what amount should you receive at the end of that time?

3. Show that the interest on any principal at 4% for 2 years or at 2% for 4 years is the same.

4. On January 1, Frank Dennis started a new savings account with a deposit of $12.75.

On July 1, the bank added to this amount 6 months' interest on $12.00 at 2% per year. Show that the total amount on deposit then was $12.87.

5. Robert Hanley borrowed $500 from his uncle for two years at 4% interest. What total amount must Robert pay his uncle at the end of two years?

6. Use the formula $i = p \times r \times t$ to find i when p = $200, r = .04, and $t = 2\frac{1}{2}$.

7. Find the interest on $500 at 2% for $4\frac{1}{2}$ yr.

8. Find the interest on $200 at 4% for 3 months.

9. Find the interest on $500 for 60 days at 6%.

10. The interest on $300 for 2 years is $24. Find the interest for 6 mo.

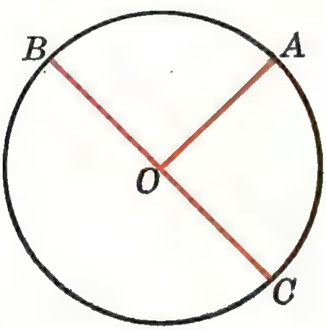
Circles

You are familiar with *circles*, for you see them every day — the wheels of an automobile and an airplane, the top of your cup or drinking glass, jar covers, coins, and many other things have the circle as their basic form.

You can draw a circle with an instrument called a ***compass***. Practice drawing circles until you can make them expertly. Use a compass as shown at the right.

1. Draw a circle like the one below. The point O is the *center* of the circle.

The line OA is a *radius*. A ***radius*** is a line from the center to any point on the curve of the circle. All radii of the same circle are equal. (*Radii* is the plural of radius.)



The line BOC is a *diameter*.

A ***diameter*** goes through the center of the circle and has its ends on the circle. A diameter is twice as long as a radius, and, of course, all diameters of the same circle are equal.

Any part of the curved line of a circle is called an ***arc***. The curve AC or the curve AB is an *arc*.

A ***semicircle*** is half a circle. The curve BAC is a *semicircle*.

2. Mark a point O on a piece of paper.

▶ Open your compass until the points are $1\frac{1}{2}''$ apart. With the point O as center and with a radius of $1\frac{1}{2}''$ draw a circle.

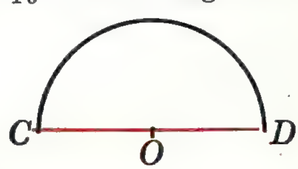
▶ Mark a point A on the curve of the circle. Draw a line from O to A. OA is a _?_ of the circle.

▶ Draw a radius OB. Without measuring tell how long OB is. OA and OB are two _?_.

▶ Mark a point C on the curve of the circle. Draw a line from C through O and continue it until it meets the circle. Mark point D where the line meets the circle.

The line CD is a _?_ of the circle. CD is _?_ in. long.

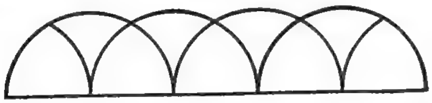
3. Below is a semicircle. The line CD is $1\frac{3}{16}''$. How long is the radius?



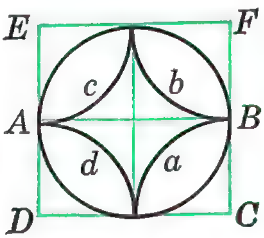
Draw a semicircle like this one.

Using the compass to make designs

1. Make a design like the one below, using a compass and a straightedge. (When the marks on a ruler are not used, the ruler is called a *straightedge.*) Use a radius of one inch.



2. Using graph paper, make a design like this one:



Make the diameter AB equal to 20 of the small units on your graph paper.

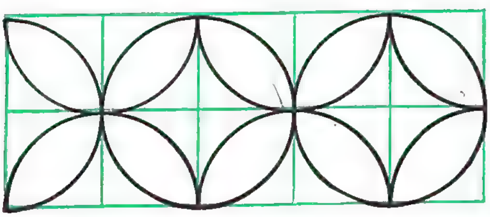
How long is the radius of the circle?

What points are used as centers for the arcs marked a, b, c, and d?

How long are the radii of these arcs?

If you wish, you can trace your design on plain tracing paper.

3. Copy this design on graph paper, using as a radius ten of the small units on your graph paper.



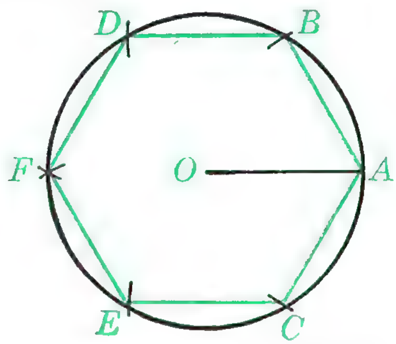
4. Many interesting designs are based on the ***regular hexagon*** (a six-sided figure whose sides and angles are equal).

Draw a regular hexagon as follows:

▶ Draw a circle.

▶ Place a point A on the curve of the circle.

▶ With A as center and a radius equal to OA, draw arcs cutting the circle at B and C.



▶ With B and C as centers and the same radius, draw arcs cutting the circle at D and E.

▶ With D and E as centers and the same radius, draw arcs cutting the circle at F. These arcs should cut at the same point. If not, try again.

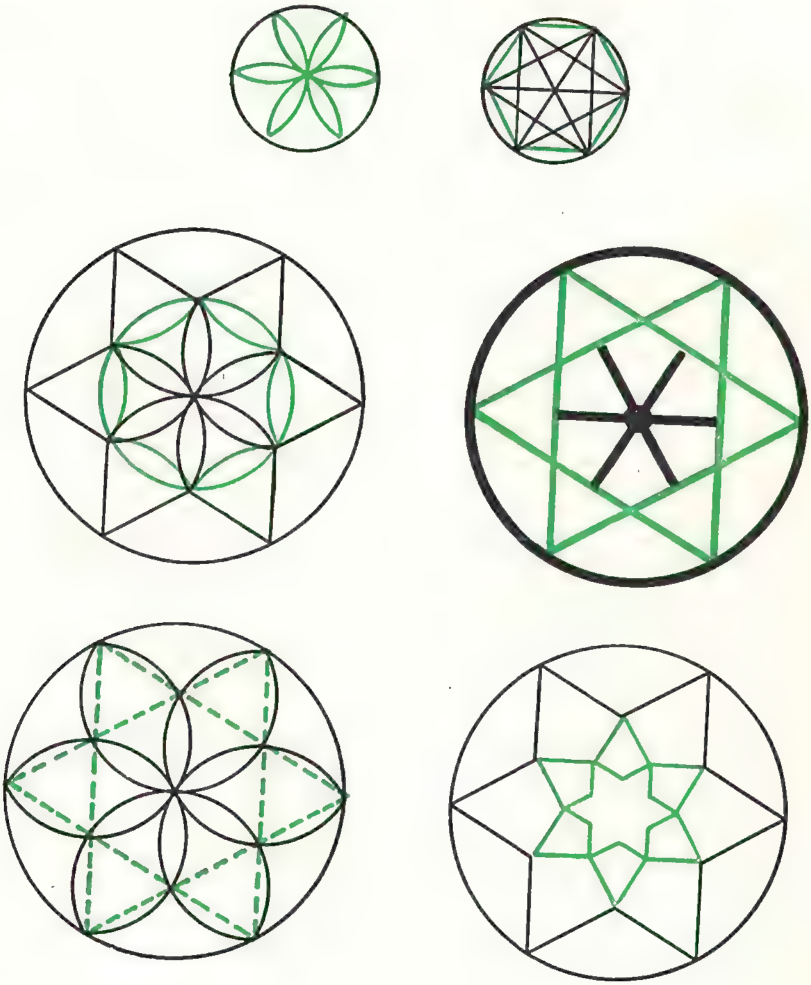
Now draw the lines AB, BD, DF, FE, EC, and CA and you will have a regular hexagon.

5. Make another circle. In it draw a hexagon as you did for Ex. 4. Draw AD, DE, and EA.

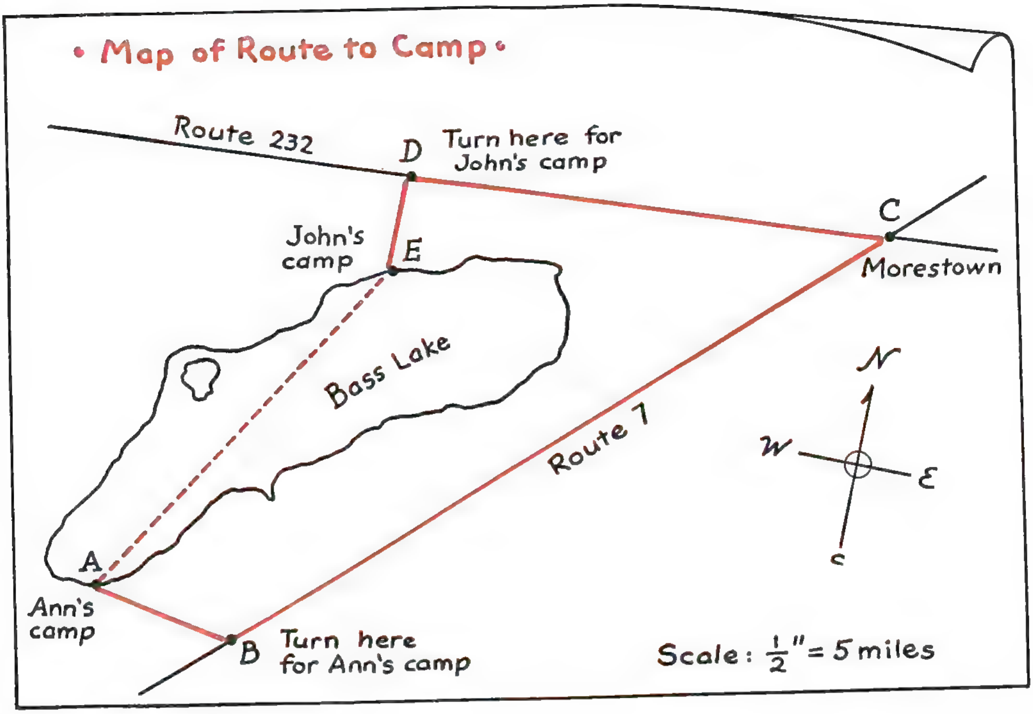
You now have an ***equilateral triangle*** (a triangle with equal sides).

Making designs

6. Copy as many of these designs as you can.



You will enjoy making up some designs of your own. You may wish to make some attractive colored-poster designs. Perhaps your art teacher will give you suggestions and help.



A scale drawing

1. John sent home a diagram like the one above to help his father and mother when they drove to his camp.

It is a *scale drawing* of the roads near his camp and his sister Ann's camp. Every $\frac{1}{2}$ inch on the drawing represents _?_ miles.

John put the mileage on each red line, but it has been left off to see if you understand scale drawings. Letters have been put at the ends of lines to make the lines easy to refer to.

2. Measure AB, BC, CD, DE, and EA. Copy and fill in the blanks.

AB = _?_ in. BC = _?_ in.
CD = _?_ in. DE = _?_ in.
EA = _?_ in.

3. $2\frac{1}{2} = \frac{?}{2}$, so $2\frac{1}{2}''$ on the diagram represents _?_ × 5 mi. = _?_ mi.

4. $\frac{1}{4}$ is what part of $\frac{1}{2}$? $\frac{1}{4}''$ represents _?_ of 5 mi.

The distance from the turn at B to Ann's camp at A is $\frac{1}{2}'' + \frac{1}{4}''$, or _?_ mi.

5. It is _?_ mi. from the town at C to the turn at D.

Then it is _?_ mi. more to John's camp at E.

6. The distance from the town to B is _?_ mi., and then it is _?_ mi. more to Ann's camp.

7. It is _?_ mi. by motor launch across the lake from John's camp to Ann's camp.

Drawing to scale

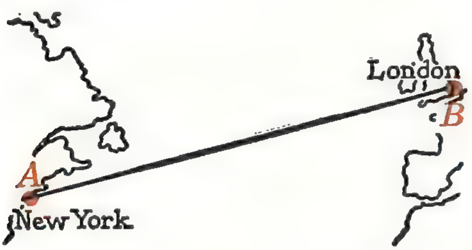
1. Using a scale of $\frac{1}{8}$ in. to 1 mi., how long are the distances represented by lines of the following lengths?

$\frac{1}{4}$ in. $\frac{1}{2}$ in. $\frac{3}{4}$ in. $2\frac{1}{2}$ in. $3\frac{5}{8}$ in.

2. Using a scale of $\frac{1}{16}$ in. to 1 mi., how long are the lines you would draw to represent each of these distances?

$\frac{1}{2}$ mi. $1\frac{1}{2}$ mi. $2\frac{1}{2}$ mi. 3 mi. 100 mi.

3. If this map is drawn to the scale of $\frac{1}{16}$ in. to 100 mi., how long a distance is represented by the $2\frac{1}{4}$-inch line AB?



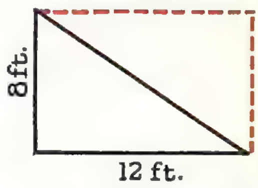
4. Draw a plan of a birdhouse, a playground, or a camp, using any convenient scale. See if your classmates can read your plan.

5. Using graph paper, draw a plan of a *rectangle* 80 rd. long and 48 rd. wide. Let the side of one square on the graph paper represent 8 rods.

How many squares are there within this rectangle? Do you know how many square rods are represented by one of these small squares?

6. Using a scale of $\frac{1}{8}$ in. to 1 ft., draw a circle to represent a circle that has an actual diameter of 16 ft.

7. Using graph paper, draw a *triangle* like the one at the right to represent a triangle with the dimensions as marked.

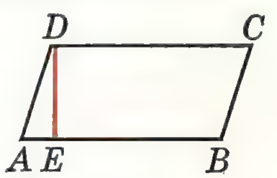


Let the side of one square on the graph paper represent 1 foot.

On the graph paper fill out the rectangle as shown by the dotted lines and count the squares within the rectangle.

Can you tell, from this count, how many squares there are within the triangle?

8. A scale of $\frac{1}{16}$ in. to 1 mi. was used in drawing the figure at the right.



AB and CD are the same length. So are AD and CB.

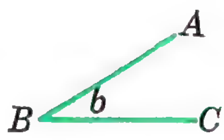
What lengths do lines AB and ED represent?

9. A plan for a house measures $6\frac{1}{4}''$ by $8\frac{3}{4}''$ (often written $6\frac{1}{4}'' \times 8\frac{3}{4}''$). If the scale is $\frac{1}{4}'' = 1'$, what are the actual dimensions of the house?

10. If possible, some members of your class should bring to class scale drawings or plans of boats, airplanes, articles of furniture, houses, garages, barns, etc. Try to interpret such drawings.

Angles

You know what an *angle* looks like. It is made of two straight lines meeting at a point like the figure shown here.



The lines AB and CB are the ***sides*** of the angle, and the point B is the ***vertex***. The symbol for angle is $\angle$.

This angle may be read angle B ($\angle B$) or angle ABC ($\angle ABC$).

Note that when three letters are used to read an angle, as $\angle ABC$, the vertex letter B is always in the middle.

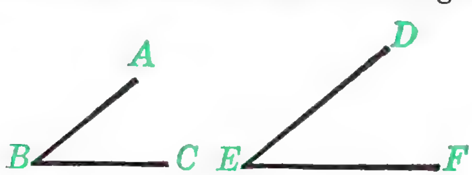
If a small letter, as b, is placed within the angle near the vertex, the angle may also be read $\angle b$.

The ***size*** of an angle depends upon the amount of opening.

Imagine that you are standing at vertex B and pointing your arm toward C. Then turn slowly to the left until you are pointing toward A. You have then turned through the angle CBA.

As you continue to turn, the angle becomes larger. When you again point along BC, you have made a *complete rotation*.

The lengths of the sides BC and BA do not affect the size of the angle.



$\angle ABC$ is the same size as $\angle DEF$.

1. With two rulers illustrate an angle. With two yardsticks illustrate an angle of about the same size.

2. With two rulers indicate an angle that is one fourth of a complete rotation (Fig. 1). This is a ***right angle***.

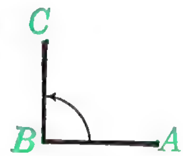


FIG. 1

3. With two rulers represent an angle that is less than a right angle (Fig. 2). This is an ***acute angle***.

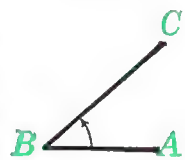


FIG. 2

4. With two rulers indicate an angle that is one half a complete rotation (Fig. 3). This is a ***straight angle***.

FIG. 3

5. Indicate an angle that is greater than a right angle and less than a straight angle (Fig. 4). This is an ***obtuse angle***.

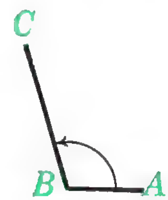
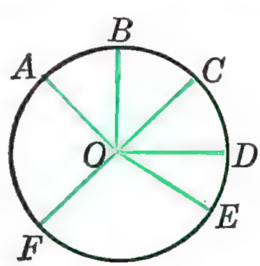


FIG. 4

6. Using 3 letters for each angle, name the straight angles, right angles, acute angles, and obtuse angles in the figure below.

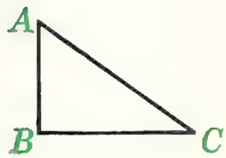


Practice with acute, right, and obtuse angles

1. What kind of angle do the hands of a clock make:

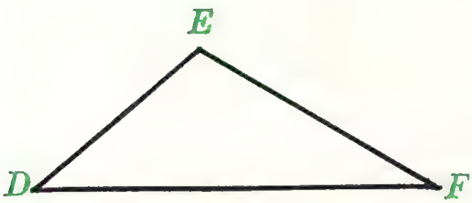
at 3 o'clock? at 1 o'clock? at 5 o'clock? at 6 o'clock?

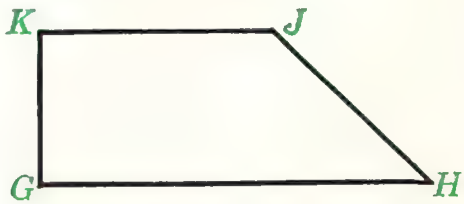
2. What kinds of angles are made at the corners of the panes of glass in the windows of your classroom?



3. The triangle *ABC* has three angles. What kind of angle is $\angle A$? $\angle B$? $\angle C$?

4. Tell what kinds of angles are shown in the figures below:





$\angle D$ is __?__.
$\angle E$ is __?__.
$\angle F$ is __?__.

$\angle G$ is __?__.
$\angle H$ is __?__.
$\angle J$ is __?__.

$\angle K$ is __?__.

5. A knowledge of angles is important to aviators. One of the simpler uses of angles is shown below.

The course of an airplane (the direction in which it is traveling) is indicated by an angle — the angle between a north-south line and the path the plane is taking.

• In Fig. 1, the course of the plane is indicated by the size of $\angle NOC$. Is it an acute angle, a right angle, or an obtuse angle?

• In Fig. 2 is $\angle NOC$ an acute angle, a right angle, or an obtuse angle?

• What kind of angle is $\angle NOC$ in Fig. 3?

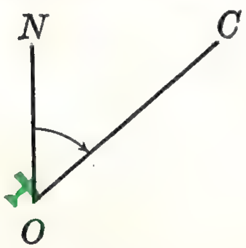


FIG. 1

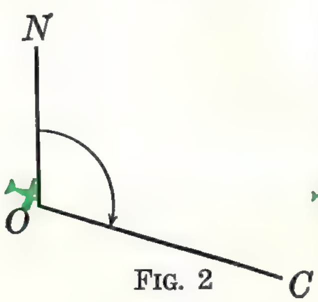


FIG. 2

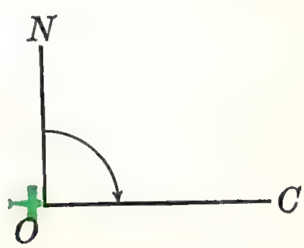
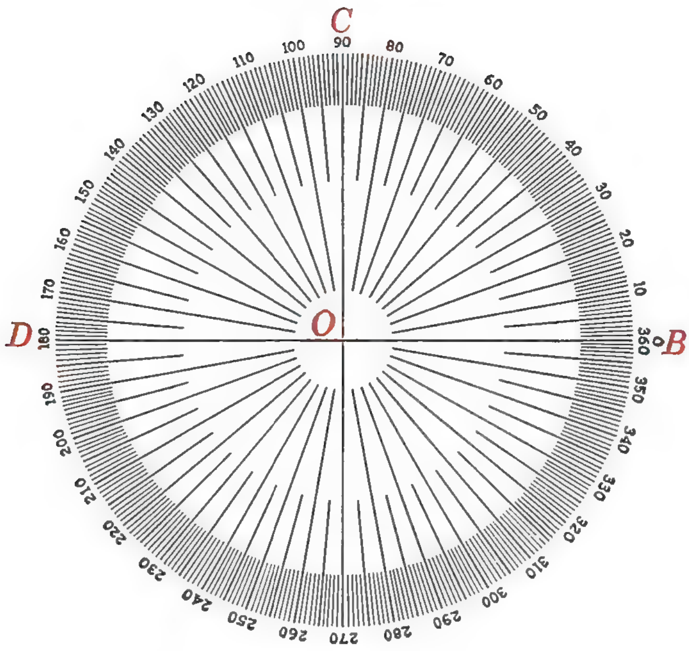


FIG. 3



Thinking about the size of an angle

1. Look at the above figure. Call the center O. Imagine a fine straight wire attached at O so that it can be rotated about O.

First think of the wire as laid along OB. Then rotate it until it lies along the line from O to 10, O to 20, O to 30, and so on.

When the wire lies along OC, it has rotated through one quarter of a complete rotation. $\angle BOC$ is a right angle.

2. Keep rotating the wire in your imagination and let it pass through the points marked 100, 110, 120, and so on.

When the wire lies along OD, it has rotated through one half of a complete rotation. $\angle BOD$ is a _?_ angle.

3. Now let the wire rotate until it returns to its starting place OB. The wire has then made one complete rotation around the point O.

The figure at the top of the page shows a complete rotation divided into 360 equal parts. Each part is an angle of 1 ***degree*** (written 1°). Can you see the 1° angles?

4. Ten of these small angles make an angle of 10°.

Beginning at B, trace with your finger tip an angle of 10°.

5. Twenty of these small angles make an angle of 20°. Beginning at B, trace an angle of 20°.

In the same way trace angles of 40°, 60°, 80°, 90°, 120°, 150°, 180°.

6. A complete rotation contains 360°. A right angle is one fourth of a complete rotation, so it is $\frac{1}{4}$ of 360°, or _?_ °.

7. A straight angle is one half of a complete rotation, so it is $\frac{1}{2}$ of 360°, or _?_ °.

8. There are _?_ right angles in a complete rotation.

9. There are _?_ right angles in a straight angle.

10. Which of the following angles are acute and which obtuse?

30°	150°	120°	60°	20°
170°	50°	20°	160°	70°

11. What part of a complete rotation is an angle of 1°? Can you trace 1° with your finger tip on the diagram on page 216?

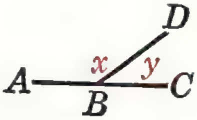
12. What part of a complete rotation is an angle of 45°? 30°? 60°?

13. If a complete rotation is marked off into 6 equal angles, each angle will contain _?_ degrees. Draw a sketch of this figure.

Answer the questions in Exs. 14–26 without measuring.

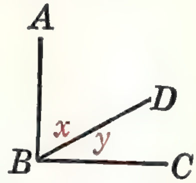
14. If ABC is a straight line, how many degrees are there in $\angle CBA$?

15. If ABC is a straight line, how many degrees are there in the sum of $\angle x$ and $\angle y$?



16. If $\angle y$ (Ex. 15) is 45°, how many degrees are there in $\angle x$?

17. If ABC is a right angle, what is the sum of $\angle x$ and $\angle y$?



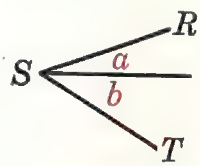
18. Is $\angle y$ acute or obtuse? (Ex. 17).

19. If $\angle x = 60°$, how many degrees are there in $\angle y$? (Ex. 17).

20. Read $\angle x$ using three letters. Read $\angle y$ using three letters. (Ex. 17).

21. What is the vertex of $\angle x$? $\angle y$? of $\angle ABC$? (Ex. 17).

22. $\angle RST = 50°$. What is the sum of $\angle a$ and $\angle b$?

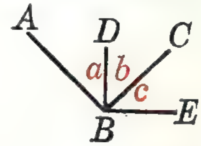


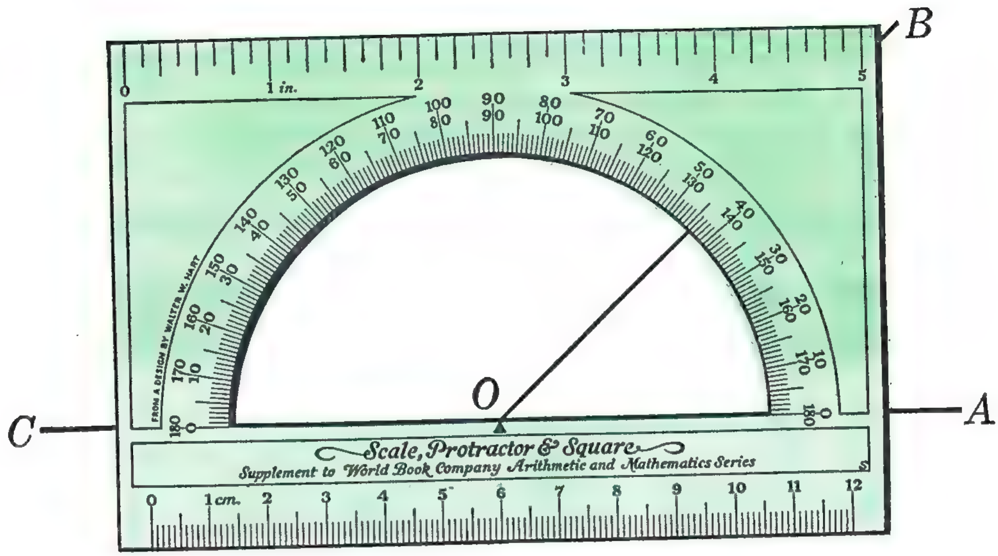
23. If $\angle a = 17°$, how many degrees are there in $\angle b$? (Ex. 22).

24. If in the figure for Ex. 22 $\angle a = 20°$ and $\angle b = 52°$, how many degrees would there be in $\angle RST$?

25. If in Ex. 22, $\angle RST$ were 84° and $\angle a$ were 25°, how many degrees would there be in $\angle b$?

26. $\angle ABC$ and $\angle DBE$ are right angles and $\angle b = 35°$. How many degrees are there in $\angle a$? in $\angle c$?





Using a protractor

The instrument for measuring angles is called a *protractor*.

You will use the protractor in the back of this book. It contains 180°.

Some protractors are circular and contain 360°. They look very much like the figure on page 216.

Protractors may be made of transparent material so that when they are placed over angles, the angle can be seen through the material.

The protractor in the illustration has been placed over $\angle AOB$ to show you how to find out how many degrees there are in the angle.

- The *center* of the protractor is at the *vertex* of the angle.
- The *base* of the protractor lies along OA, one side of the angle.
- The size of the angle is shown at the point where OB, the other side of the angle, meets the scale.

1. Which of the two scales do you think shows the size of $\angle AOB$?

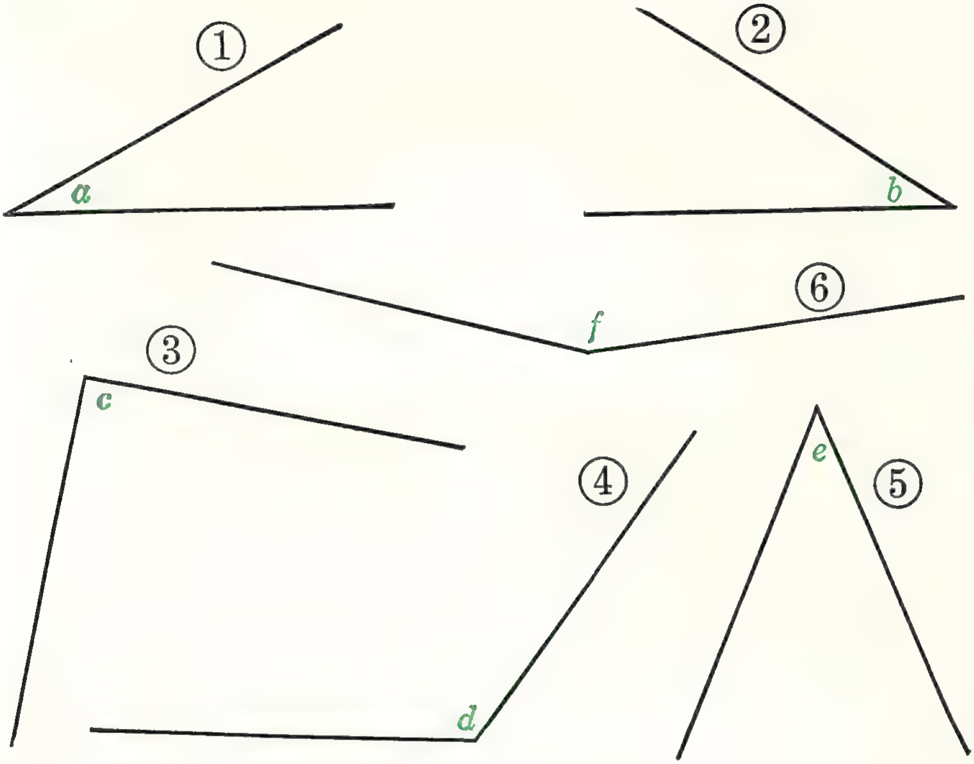
You can tell at a glance that $\angle AOB$ is acute and so must be less than 90°. That is one way to tell which scale to use.

Another way is to use the scale that begins at 0° on OA and follow that scale around until you reach OB.

The angle is 44°. If you note that OB crosses the scale between 40° and 50°, you will not make the mistake of saying the angle is 56°.

2. How many degrees are there in $\angle COB$?

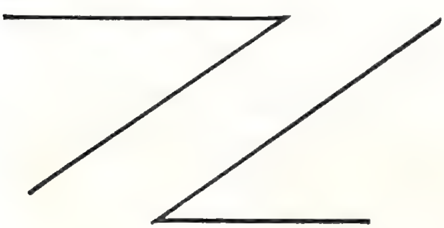
In this case you use the scale that begins at 0° on OC and follow that scale around until you reach OB. The angle is _?_. If you note that OB crosses this scale between 130° and 140°, you will not make the mistake of saying the angle is 144°.



1. Measure the angles above with our protractor. How many degrees re there in each?

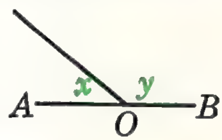
2. What difficulty do ou have in measuring this ıgle?

3. In order to measure an angle, is sometimes necessary to __?__ the des (see Ex. 2). Measure these two ıgles.



4. In this figure, AOB is a straight line.

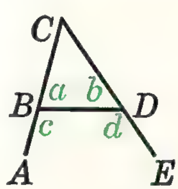
Measure $\angle x$. How many degrees are there in $\angle x$?



Now tell how many degrees there are in $\angle y$ without measuring.

5. ABC and EDC are straight lines. How many degrees are there in $\angle ABC$? in $\angle EDC$?

If $\angle a = 75°$ and $\angle b = 55°$, without measuring find how many degrees there are in $\angle c$ and in $\angle d$.



The angles of a triangle

1. Draw a triangle that looks somewhat like the triangle in Fig. 1, but large enough so that you can measure the angles.

What is the sum of angles A, B, and C?

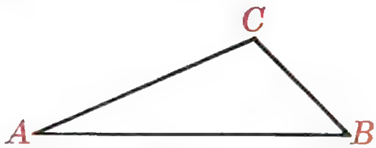


FIG. 1

2. Draw a triangle that looks somewhat like the triangle in Fig. 2.

What is the sum of angles R, S, and T?

FIG. 2

3. Draw another triangle of any shape you please. What is the sum of its angles?

4. Compare your answers to Exs. 1–3 with the answers of your classmates. Is there any general agreement?

If your instruments were accurate and you could measure with great precision, you would find that all your answers were very close to 180°.

The sum of the angles of any triangle is 180°

5. You now have a way of testin your ability to measure angles.

Draw any triangle, measure th three angles, and find their sum.

If the sum is not close to 180° you should ask for help in measurin angles and practice some more.

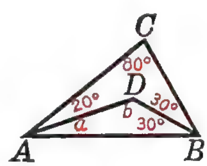
6. In a triangle, one angle is 90 and a second angle is 60°. How man degrees are there in the third angle?

7. In a triangle ABC, $\angle B = 40$ and the other two angles are equal How many degrees are there in $\angle A$ and in $\angle C$?

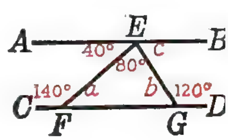
8. If the angles of a triangle ar equal, how many degrees are there i each angle?

9. Frank measured the angles o a triangle and found them to be 90° 120°, and 30°. Can you tell what mis take he made in measuring the thre angles?

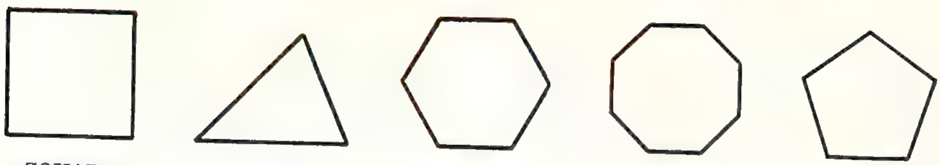
10. Can you find how many degrees there are in $\angle a$ and $\angle b$ in the figure at the right without measuring?



11. Can you find the number of degrees in $\angle a$, $\angle b$, and $\angle c$ in this figure without measuring?



Geometric figures and their names

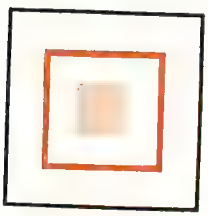


SQUARE TRIANGLE HEXAGON OCTAGON PENTAGON

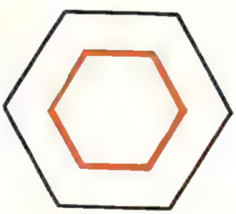
You are familiar with the names of some of the figures above. Others may be new to you. Be sure that you can recognize them and name them when you see them. All five figures are called ***polygons***.

1. How many sides has a square? a triangle? a hexagon? an octagon? a pentagon?

2. Below are designs you see in rugs, in linoleum, and in cloth. Tell what geometric figures you see in each design.

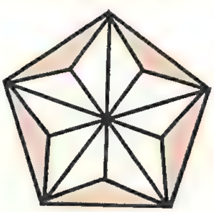


1



2

3

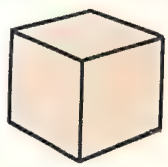


4

3. Below is shown a patchwork design. Draw a sketch of each geometric figure you see in the design and name it.

4. A flat surface is called a ***plane***. All the figures in Exs. 1–3 are called ***plane figures***, because they are flat and can be drawn on a flat surface. They have *length* and *breadth*.

Can you give some examples of objects that have the shapes of the two figures at the right?

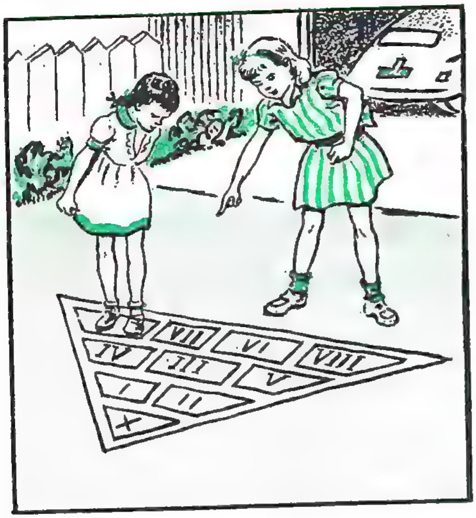


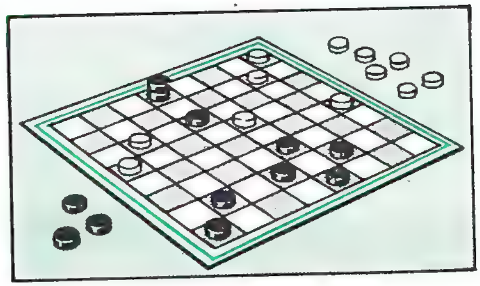
CUBE

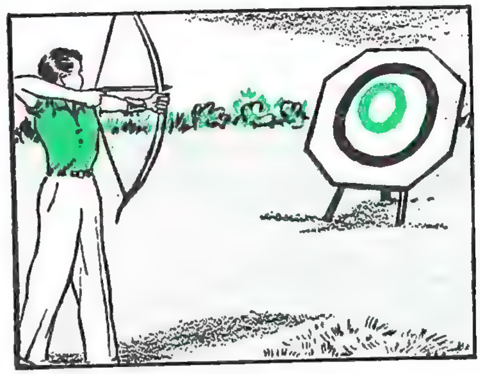
RECTANGULAR SOLID

These figures cannot be drawn in their true shapes on a flat surface. They are ***solids***. They have *length*, *breadth*, and *height*.

More about geometric figures

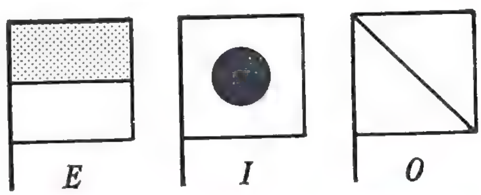




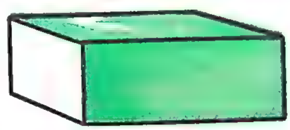


1. The pictures here illustrate the use of geometric figures in games and sports. What figures do you recognize?

2. At the right are three flags of the International Alphabet. They are used for sending messages from ship to ship. They represent the letters *E*, *I*, and *O*. What geometric figures are used?



3. At the right are pictures of a ***rectangular solid*** and a ***cylinder.*** Some of the sentences below apply to a rectangular solid and some apply to a cylinder. To which figure does each sentence apply?



a. It will roll.
b. It has only 2 flat faces.
c. It has 1 curved surface.
d. It has 6 flat surfaces.
e. It has 8 corners or vertices.
f. It has no corners.
g. It has 2 circular faces.
h. It has 12 edges.
i. Its flat faces are rectangles.

Perimeters

The *perimeter* of a geometric figure is the distance around it.

For example, the perimeter of a triangle is the sum of its three sides.

The perimeter of a hexagon is the sum of its six sides.

The perimeter of the rectangle below is $1'' + \frac{1}{2}'' + 1'' + \frac{1}{2}'' = 3''$.

1. What is the perimeter of a triangle whose three sides are 3", 4", and 5"?

2. What is the perimeter of a triangle whose three sides are $3\frac{3}{4}''$, $2\frac{1}{2}''$, and $1\frac{1}{4}''$?

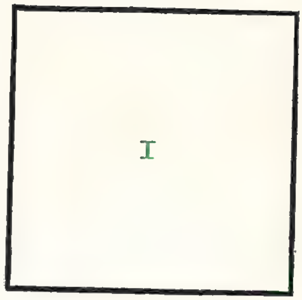
3. Measure the sides of each of the geometric figures at the right and find the perimeter of each figure.

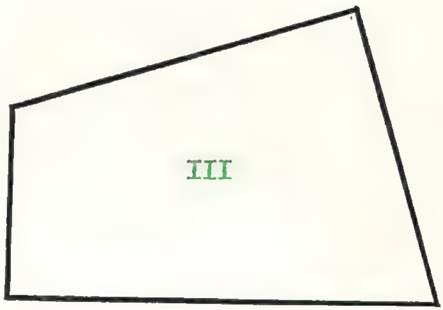
4. Explain what is meant by the *length* of a rectangle. What is the *width* of a rectangle?

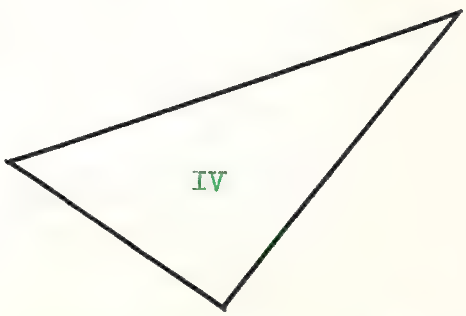
5. Do you know what is meant when we say "a 9′ by 12′ rug"?

6. How many feet of weather stripping would you need to put around a 4′ by $6\frac{1}{2}'$ picture window?

7. You can find the perimeter of a square each of whose sides is $1\frac{1}{4}''$ by adding $1\frac{1}{4} + 1\frac{1}{4} + 1\frac{1}{4} + 1\frac{1}{4}$. Can you explain an easier way?

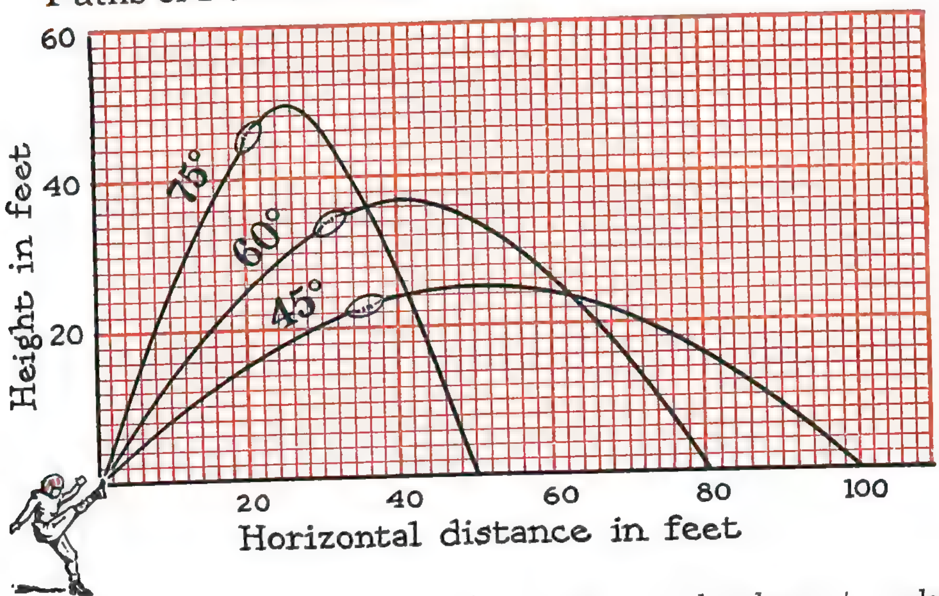






Kicking a football

Paths of Football Kicked at Angles of 45°, 60°, 75°



These graphs show the paths that a football would take if it were kicked into the air at a speed of 40 feet per second at angles of 45°, 60°, 75°. Air resistance is not considered.

Choose the best answer:

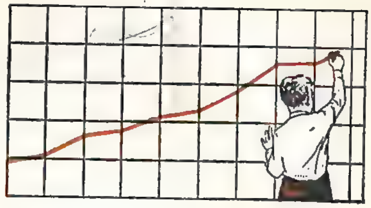
1. The graphs show at a glance that the football will go highest (in these three cases) when the angle is (75°, 60°, 45°).

2. The graphs show at a glance that the football will go farthest when the angle is (75°, 60°, 45°).

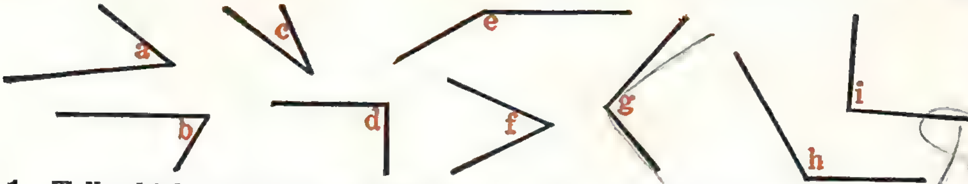
3. If the ball is kicked at 75°, the highest point it will reach is (25′, 45′, 50′).

4. If the ball is kicked at 45°, it will strike the ground again at (25′, 38′, 100′).

Measuring your growth in arithmetic



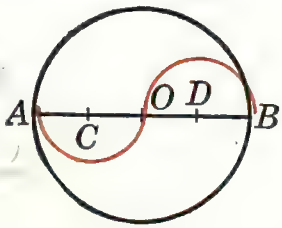
Test 8a



1. Tell which of the angles above are acute, obtuse, and right.

2. If line AB shown below is 2 in., how long are AO, AC, and OD?

3. If a line 4 in. long represents 1 ft., a line __?__ in. long represents 13 ft.



(Ex. 2)

4. If a line $\frac{1}{4}$ in. long represents 1 ft., a line $1\frac{3}{4}$ in. long represents __?__ ft.

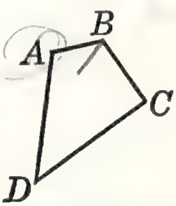
5. Using a scale of $\frac{1}{8}''$ to $1'$, draw a line to represent 15 ft.

6. Using a scale of $1''$ to $40'$, represent a $150'$ by $100'$ playground.

7. Is $\angle B$ acute or obtuse?

8. Is $\angle D$ acute or obtuse?

9. Which $\angle$ is larger, $\angle A$ or $\angle B$?

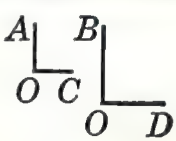


(Exs. 7–9)

10. What is the perimeter of a rectangle $6'$ by $8'$?

Test 8b

1. Compare $\angle AOC$ with $\angle BOD$ without measuring.

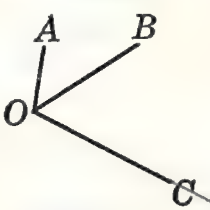


(Ex. 1)

2. Draw a large four-sided figure. Measure the angles. Their sum is __?__°.

3. Measure $\angle AOB$. It is __?__°.

4. Measure $\angle AOC$. It is __?__°.

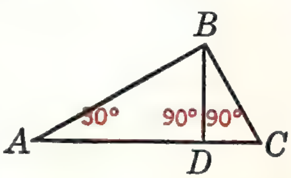


(Exs. 3–4)

5. If the three angles of a triangle are equal, each is a __?__° angle.

6. In a triangle ABC, $\angle A$ and $\angle B$ are each 50°. $\angle C =$ __?__°.

7. $\angle ABC$ in this figure is 90°. How many degrees are there in $\angle ABD$?



8. How many degrees in $\angle DBC$?

9. How many degrees in $\angle DCB$?

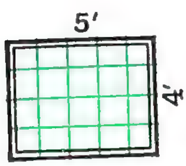
10. In one hour the minute hand of a clock turns through __?__°.

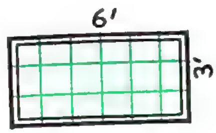
UNIT 16

Areas of rectangles, squares, triangles, and parallelograms

Area

1. The figures below represent the floor spaces in two closets. One is $5' \times 4'$; the other is $6' \times 3'$. How many feet of molding are required to go around each of these floors? What is the perimeter of each floor?





2. The floors in Ex. 1 are to be covered with linoleum. Which floor has more surface to be covered? (Count the squares.)

Surface is measured in ***square units.*** The floors shown above are drawn to scale; each square unit is 1 ft. on a side. A square that is 1 ft. on a side is called a ***square foot*** (sq. ft.).

The floor on the left contains 20 squares. We say that its ***area*** is 20 square feet. The area of the other floor is 18 square feet.

3. A square that is one inch on each side is a ***square inch*** (sq. in.). What is a *square yard?* a *square mile?*

4. Draw several square inches on graph paper and cut them out.

5. Make a model of a square foot and of a square yard, using heavy cardboard.

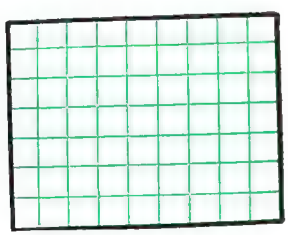
6. At the bottom of the page are scale drawings of Tom's, Jim's and Bill's gardens. What is the scale of the drawings?

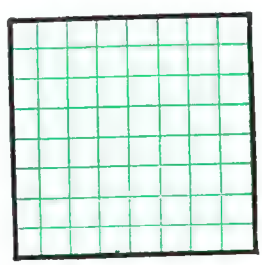
What does each small square in the drawings represent?

7. What is the area of each garden? Find out by counting the squares.

8. Tom's garden is _?_ ft. wide and _?_ ft. long. Jim's garden is _?_′ × _?_′. Bill's garden is $11' \times 5'$ plus _?_′ × _?_′.

Can you see an easy way to find the areas?

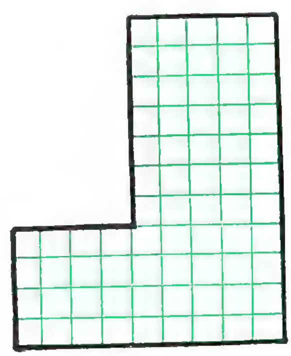




Scale: The side of one of the small squares represents one foot.

TOM'S GARDEN

JIM'S GARDEN



BILL'S GARDEN

9. Find the areas of Figs. 1, 2, 3 and 4 below. Count 2 half-squares as one whole square. In Fig. 4 give the area of the unshaded part only.

10. Counting squares is not an easy or accurate way to find areas. Do Figs. 5, 6 and 7 below help you to explain this statement?

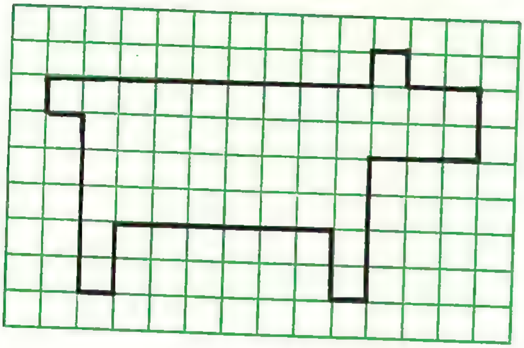


FIG. 1

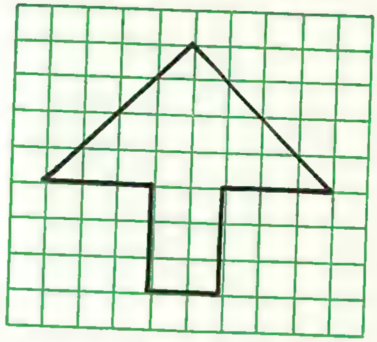


FIG. 2

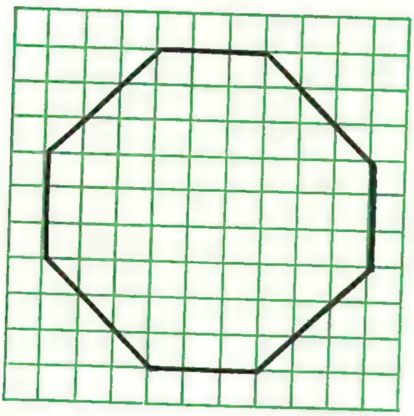


FIG. 3

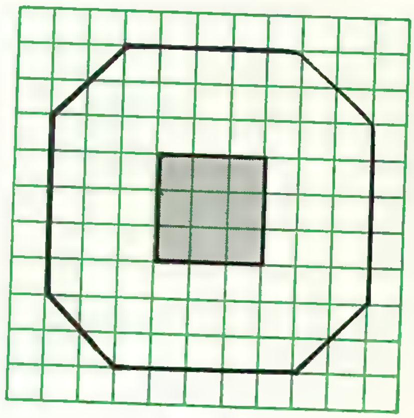


FIG. 4

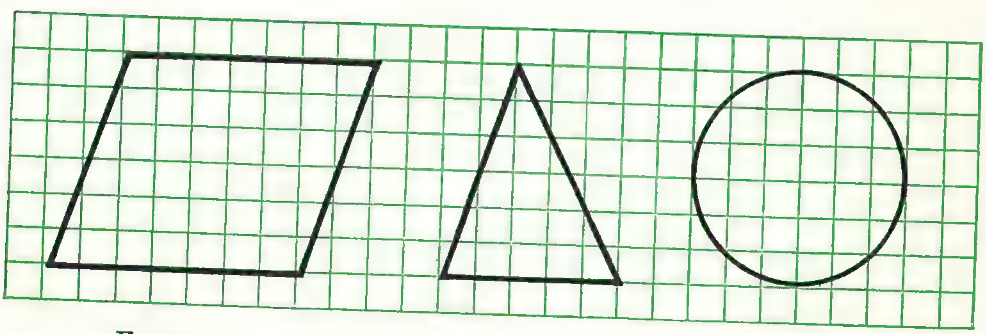


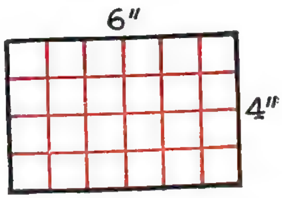
FIG. 5

FIG. 6

FIG. 7

Area of a rectangle

1. Below is a scale drawing of a $6'' \times 4''$ rectangle. How many square inches does it contain? Explain an easy method of finding the number of squares without counting them.



The area of any rectangle can be found by multiplying the number of units in the length by the number of units in the width.

Both dimensions must be expressed in the same kind of units. The length and the width of a rectangle are often called its ***base*** and ***height*** (or ***altitude***).

The above rule can be written as a *formula:*

$$A = lw$$

In this formula A is the number of square units in the area, l the number of units in the length, and w the number of units in the width.

lw means $l \times w$.

2. To find the area of a rectangle 6 in. long and 3 in. wide, think:

▶ $A = lw$
▶ I know that $l = 6''$ and $w = 3''$
▶ So $A = 6 \times 3 = \underline{\ ?\ }$
▶ $A = 18$ square inches

3. To find the area of a rectangle 1 yard wide and $4\frac{1}{2}$ feet long, think:

▶ $A = lw$
▶ I know that $l = 4\frac{1}{2}$ ft. and $w =$ 1 yd. $= 3$ ft.
▶ So $A = 4\frac{1}{2} \times 3 = \underline{\ ?\ }$
▶ $A = 13\frac{1}{2}$ square feet

Using the formula $A = lw$, find the area of each of the rectangles whose dimensions are given below:

4. $10'' \times 6''$ $\qquad$ $24'' \times 18''$

5. $2' \times 1\frac{3}{4}''$ $\qquad$ $2\frac{1}{2}' \times 3\frac{1}{4}''$

6. $6'' \times 4\frac{1}{2}''$ $\qquad$ $6.2' \times 3.5'$

7. 6 ft. by 4 ft. 4 in.

8. 3 ft. by 3 ft. 9 in.

9. 2 ft. 6 in. by 3 ft. 6 in.

10. How many square inches of material are needed to cover a bulletin board 20 inches long and 18 inches wide?

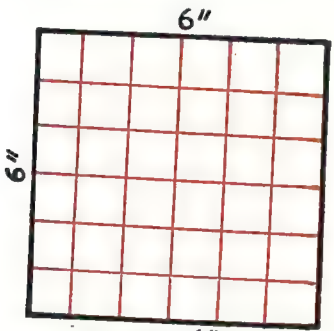
11. John mows a lawn 50 feet long and 40 feet wide for a neighbor. Then he mows his own lawn 65 feet long and 35 feet wide. Which is the larger lawn? By how much is it larger?

12. Mr. Frank wants to sow grass seed on a lawn 50 feet long and 25 feet wide. The directions on the box of seed say: "Use 1 pound of seed per 125 square feet." How many pounds of seed should he use?

Area of a square

1. If all four sides of a rectangle are __?__, the figure is a square.

2. Below is a scale drawing representing a square 6″ on a side. It contains 6×6 or __?__ sq. in. Its area is __?__ sq. in.



Scale: $\frac{1}{4}$″ = 1″

3. The area of a square 5″ on a side is __?__ × __?__ or __?__ sq. in.

Find the areas of squares whose sides are as follows:

	a	*b*	*c*
4.	7 in.	2.5 in.	2 ft. 6 in.
5.	9 ft.	4.6 ft.	4 ft. 4 in.
6.	$2\frac{1}{2}$ yd.	$4\frac{1}{3}$ yd.	3 yd. 1 ft.

7. How many square feet of flooring are needed to cover the floor in a square room 14 ft. on a side?

8. 6×6 can be written as 6^2 (read: *6 square, or the square of 6*).

- 10×10 can be written as 10^2.
- 5^2 means 5×5.
- 7^2 means __?__ × __?__.
- 12^2 means __?__ × __?__.

9. If one side of a square is 5 in., the area is 5^2 or __?__ sq. in.

If s represents the number of units in a side of a square, then the formula for finding the area is $A = s \times s$. It is commonly written:

$$A = s^2$$

and is read *A equals s square.*

10. To find how many square inches there are in a square sheet of cardboard 20 in. on each side, think:

- ▶ $A = s^2$
- ▶ I know that $s = 20$ in.
- ▶ So $A = 20^2 = 20 \times 20 =$ __?__
- ▶ The area is __?__ square inches.

Using the formula $A = s^2$ find the area of each of the squares with the length of a side as given below:

	a	*b*	*c*
11.	12 in.	15 in.	20 in.
12.	$7\frac{1}{2}$ in.	$6\frac{1}{4}$ in.	3.5 in.
13.	7.3 ft.	10.7 yd.	9.6 ft.

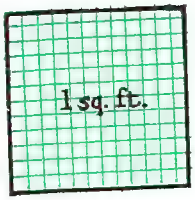
14. A baseball diamond is a square 90 feet on a side. What is its perimeter? What is its area in square feet?

15. A 4-inch square is a square 4 inches on each side. Which has the greater area, a 4-inch square or a square whose area is 4 square inches?

16. A 3-inch square contains __?__ square inches.

Square measure

1. A square foot, as you know, is a square 1 foot on a side. At the right is a scale drawing of a square foot.



Can you tell from the drawing how many square inches there are in a square foot?

2. 1 square foot = _?_ × _?_ or _?_ square inches.

3. A square yard is a square 1 yard on each side. Make a scale drawing of a square yard and divide it into square feet. A square yard contains _?_ × _?_ or _?_ square feet.

SQUARE MEASURE	
1 square foot	= 144 square inches
1 square yard	= 9 square feet

4. On a test a teacher asked the question: "What is the area of a rectangle whose width is 8 inches and whose length is $1\frac{1}{2}$ feet?"

Here are two of the solutions given by the class:

$A = lw$	$A = lw$
$l = 1\frac{1}{2};\ w = \frac{2}{3}$	$l = 18;\ w = 8$
$A = 1\frac{1}{2} \times \frac{2}{3}$	$A = 18 \times 8$
$A = 1$ (sq. ft.)	$A = 144$ (sq. in.)

Are both of these solutions correct? Explain.

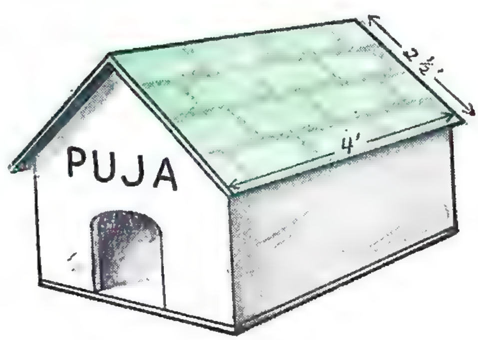
5. Mr. Wall has a den that is $9' \times 6'$. How many square yards of linoleum should he buy to cover the floor?

6. If a board is 8 feet long and 6 inches wide, what is its area in square feet? What is its area in square inches?

7. A garden 32 ft. by 48 ft. contains a 2-foot walk laid inside the garden, along all four sides. There is also a 2-foot path through the "middle and parallel to the short side." How much area is there for cultivation? (Make a sketch. Watch out for overlap.)

8. The boys in the trade school cemented a sidewalk 8 ft. wide and 24 ft. long. How much did they save the school if the labor would have cost $1.50 per square yard?

9. How many square feet of roofing paper does Bill need in order to put a new roof on the dog house shown in the illustration?



Squares and rectangles

1. John mows a 12-foot-square lawn. Bill mows 12 square feet on each side of the house. Which boy mows the greater number of square feet of lawn?

2. In this table s stands for the length of the side of a square and A stands for the area of the square. Copy the table and fill in the missing numbers:

If s is	1	2	3	4	5	10	20	30
A is	1	4	9	?	?	?	?	?

3. In the table (Ex. 2) if s increases from 1 to 2, then A increases from 1 to 4. If s increases from 2 to 4, then A increases from __?__ to __?__. If s is doubled, then A is multiplied by __?__.

4. Tom had a garden 6 yards by 8 yards. He wondered how many squares 6 feet on a side there were in the garden. Can you tell? Draw a diagram.

5. Would you estimate the area of a square each side of which is $19\frac{1}{2}$ ft. to be more than 400 sq. ft.? Why not?

6. Tom said that the area of a square each side of which is $7\frac{3}{4}$ yd. is more than 49 square yards and less than 64 square yards. How could he tell that?

7. If it costs \$6 to varnish a floor 8 ft. by 12 ft., how much should it cost to varnish a floor 16 ft. by 24 ft.?

8. Tom wanted his garden to be 48 ft. long, and wide enough so that the area would be 960 square feet. How wide should it be?

Estimate the areas of squares whose sides are:

	a	*b*	*c*
9.	2 ft. 1 in.	49 in.	1 ft. 11 in.
10.	11.9 ft.	61 in.	12.1 ft.
11.	1.1 mi.	.96 mi.	6 ft. $7\frac{1}{2}$ in.

12. John said that all squares are rectangles but not all rectangles are squares. Do you agree with John?

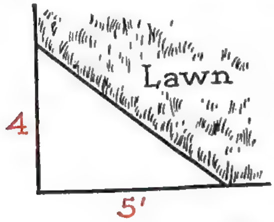
13. John also said that a closed figure whose angles are all right angles must be a rectangle. Do you agree with him?

Copy and fill in the missing numbers:

	l	w	A
14.	1 ft.	1 in.	? sq. in.
15.	12 ft.	1 in.	? sq. ft.
16.	24 ft.	1 in.	? sq. ft.
17.	1 yd.	1 ft.	? sq. yd.
18.	3 yd.	$\frac{1}{2}$ yd.	? sq. yd.
19.	20 ft.	? ft.	40 sq. ft.
20.	1 ft.	? ft.	1 sq. ft.
21.	? ft.	5 ft.	20 sq. ft.

Area of a right triangle

Earl Phillips has a good lawn except where people have worn off all the grass by cutting across the corner.

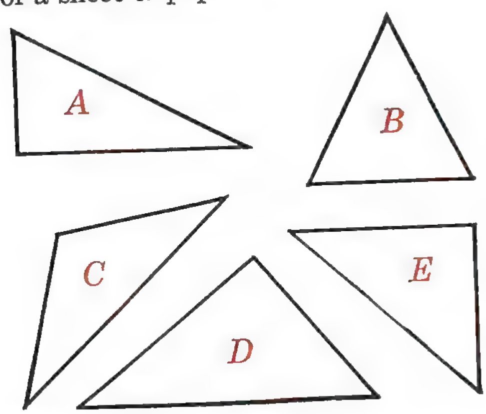


To find out how much grass seed he should use to reseed the damaged area, he needs to know how to find the area of a *right triangle*. A *right triangle* is a triangle one of whose angles is a right angle.

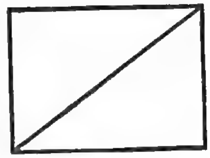
The *base* and the *height* (or *altitude*) of a right triangle are the two lines that form the right angle.

1. Figures *A*, *B*, *C*, *D*, and *E* are triangles. Triangle *A* has a square corner; it contains a right angle; it is a right triangle.

Find out which of the other triangles are right triangles by seeing which angles will fit the square corner of a sheet of paper.

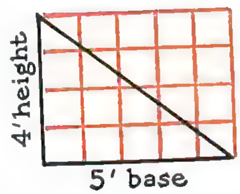


2. Take a rectangular piece of paper, and draw a straight line from one corner to the opposite corner as shown above.



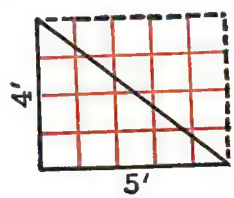
Cut the rectangle into two pieces along this line. How many right triangles are formed? Can you make one fit over the other? Are they equal?

3. This figure represents the right triangle at the corner of Earl Phillips' lot.



Its base is 5′ and its height is 4′. If you multiply the base by the height you will get 20. Does this triangle contain 20 sq. ft.? (Count the whole squares and estimate how many whole squares would be made by the parts of squares.)

4. At the right is shown the triangle of Ex. 3 with dotted lines drawn to form a rectangle. The area of the rectangle is __?__ sq. ft. The triangle is $\frac{1}{2}$ of the rectangle, so the area of the triangle is __?__ sq. ft. Does your answer check with your estimate (Ex. 3) of the number of squares in the triangle?



Using squared paper, find the area of right triangles whose dimensions are given below. First complete the rectangle as was done in Ex. 4.

	BASE	HEIGHT	BASE	HEIGHT
5.	6 ft.	4 ft.	6 in.	5 in.
6.	4 ft.	4 ft.	3 yd.	2 yd.
7.	10 in.	5 in.	5 in.	3 in.

8. If you can, state a rule for finding the area of a right triangle when you know the base and the height.

The area of any right triangle can be found by multiplying the number of units in the base by the number of units in the height (or altitude), and then taking one half of the product.

$$A = \frac{1}{2}\, bh.$$

9. Does $\frac{1}{2}bh$ mean $\frac{1}{2} + b + h$ or $\frac{1}{2} \times b \times h$?

10. If b is 6 and h is $4\frac{1}{2}$, then $\frac{1}{2}bh$ is $\frac{1}{2} \times 6 \times 4\frac{1}{2}$, or __?__.

11. Tom wanted to use the formula $A = \frac{1}{2}bh$ to find the area of a right triangle with a base of 8″ and a height of $3\frac{1}{2}$″.

He knew that $b = 8$ and $h = 3\frac{1}{2}$. He wrote: $A = \frac{1}{2} \times 8 \times 3\frac{1}{2}$.

He found the area of the triangle to be __?__ sq. in.

12. If in the formula $A = \frac{1}{2}bh$ $b = 3$ and $h = 4$, then $A =$ __?__.

Using the formula $A = \frac{1}{2}bh$, find the areas of the following right triangles:

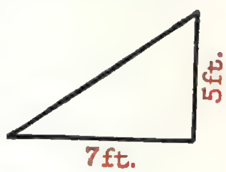
	BASE	HEIGHT	BASE	HEIGHT
13.	3 ft.	3 ft.	2 ft.	9 in.
14.	4 in.	9 in.	3 ft. 6 in.	6 in.
15.	3 yd.	5 yd.	2 ft. 4 in.	2 ft.
16.	$5\frac{1}{2}$ in.	$3\frac{1}{2}$ in.	5 ft. 3 in.	4 in.

17. The base and the height of a certain rectangle are equal to the base and the height of a right triangle.

● Is the rectangle twice as large as the right triangle? Explain.

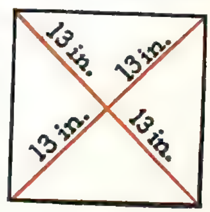
● Can you draw a line in the rectangle to divide the rectangle into two triangles each equal to the right triangle? Explain.

18. At each side of the entrance to the school building the Hawthorne School Recreation Club has planted beds of evergreen bushes. Each bed is shaped like a right triangle with the measurements as shown.



How many square feet of land are there in each bed?

19. At the right is a picture of a pillow top made by sewing together four right-triangular pieces of cloth with the dimensions as given.



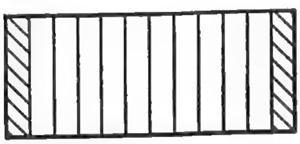
The four triangles make a square. What is the area of the square?

Parallel lines

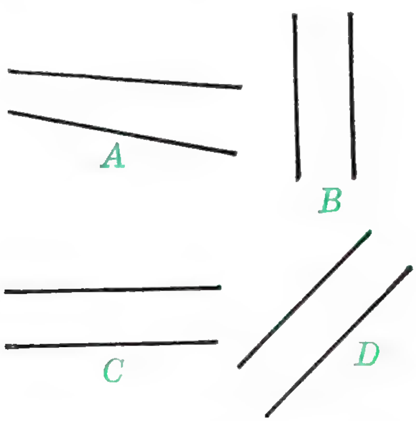
You are familiar with ***parallel lines.*** The lines printed on the paper you use in school are parallel lines because they are everywhere the same distance apart.

Have you ever noticed the rails of a straight railroad track? They are everywhere the same distance apart. They both go in the same direction. They are parallel.

Corn generally is planted in parallel rows. The sides of straight streets are usually parallel lines. Music is written on five parallel lines. The lines on a football field are parallel lines.

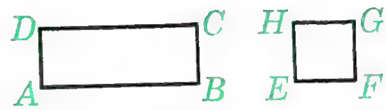


1. Look at the lines below. Which pair would meet if extended?

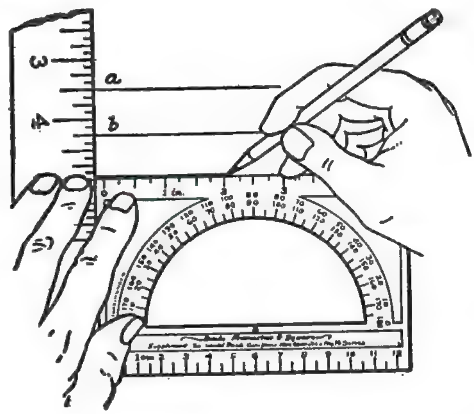


2. Which pairs are parallel?

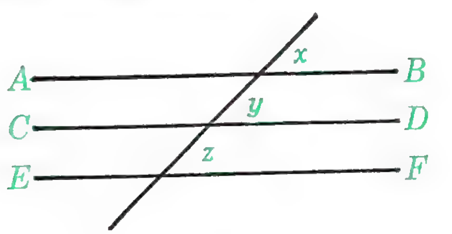
3. What lines in these figures are parallel? What is the name of each figure?

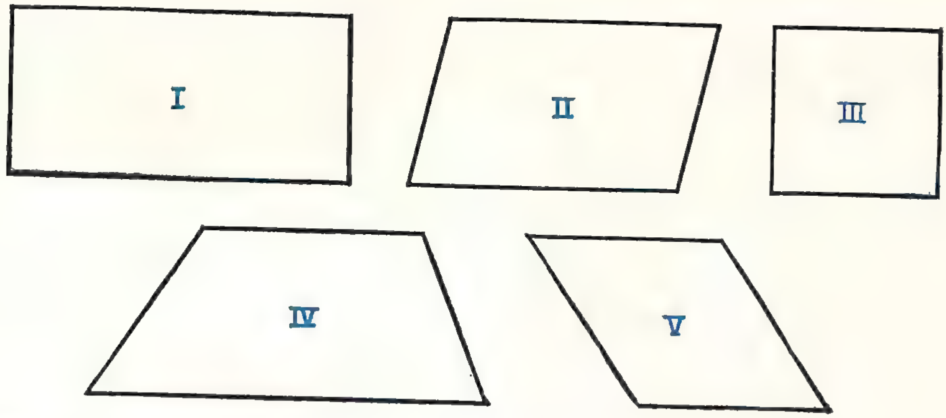


4. Parallel lines may be drawn with a ruler and a square-cornered card as shown below. What kind of angles are angles a and b? Draw three parallel lines using this method.



5. Use the lines on a piece of ruled paper to help you draw a figure like the one shown below. It represents three parallel streets crossed by a fourth street. Measure angles x, y, and z. What do you note about the size of these angles?





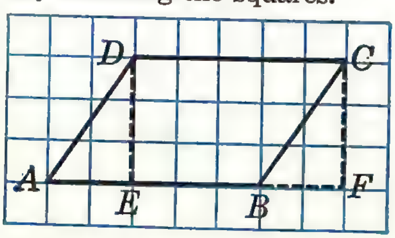
Area of a parallelogram by counting squares

A ***parallelogram*** is a four-sided figure whose opposite sides are parallel.

1. At the top of the page are pictured some four-sided figures. Which ones seem to have their opposite sides parallel? Which ones do you think are parallelograms?

Rectangles and squares (see Figs. I and III) have their opposite sides parallel. So rectangles and squares are parallelograms. The general, or more usual, parallelogram is a figure like II or V. The angles in a parallelogram may or may not be right angles, but the height *must always form a right angle* with the base.

2. Below is a parallelogram $ABCD$ whose base AB is 5 units and whose height ED is 3 units. Estimate its area by counting the squares.

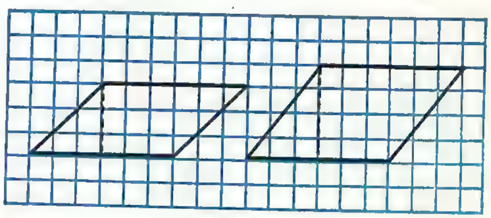


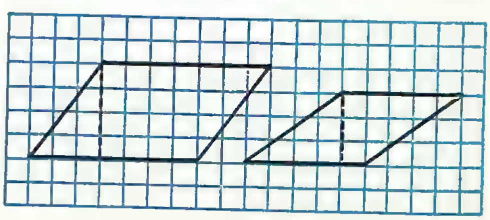
3. The dotted lines in the figure below Ex. 2 show how you can cut off a triangle (AED) from the left side of the parallelogram, put it on the right side as triangle BFC, and thus make a rectangle $EFCD$.

Make a rectangle out of a parallelogram as explained above.

4. Count the squares in the newly formed rectangle of Ex. 3. What is the area of the rectangle? of the original parallelogram? Explain.

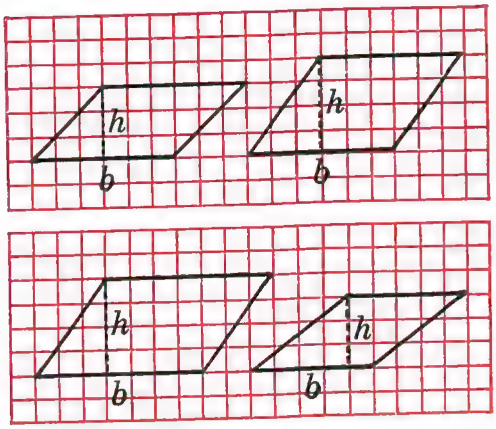
5. Copy the following figures and find the areas as in Exs. 3 and 4.





Area of a parallelogram by formula

1. The following parallelograms are the same as those in Ex. 5 at the bottom of page 235.



By making the first parallelogram into a rectangle and counting the squares you found the area to be 18 square units.

The base is 6 units. The height is 3 units. $6 \times 3 = 18$. Which is easier, to count the squares or to multiply the base by the height?

2. Explain an easy way to find the area of the other three parallelograms in Ex. 1.

The area of any parallelogram can be found by multiplying the number of units in the base by the number of units in the height (or altitude).

The formula for the area of a parallelogram is:

$$A = bh$$

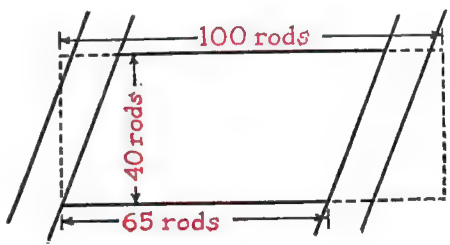
3. To find the area of a parallelogram with a base of 12 in. and a height of 9 in., think:

▶ $A = bh$
▶ I know that $b = 12''$ and $h = 9''$
▶ So $A = 12 \times 9 =$ _?_
▶ $A = 108$ square inches

Using the formula $A = bh$, find the areas of the parallelograms whose bases and heights are given:

	BASE	HEIGHT	BASE	HEIGHT
4.	7 ft.	2 ft.	3 ft.	5 ft. 4 in.
5.	9 in.	4 in.	2 yd.	3 yd. 2 ft.
6.	6 yd.	5 yd.	2 yd.	9 yd. 1 ft.
7.	$5\frac{1}{2}$ ft.	$4\frac{1}{2}$ ft.	1 ft.	5 yd. 2 ft.

8. Two parallel roads were built across Mr. Bent's land as shown below. The field that lies between the roads is a parallelogram.



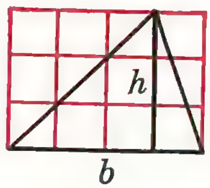
His old field was a rectangle 100 rd. × 40 rd. The new field has a base of 65 rd. and a height of 40 rd.

How many square rods was the area of the old field decreased by the two roads?

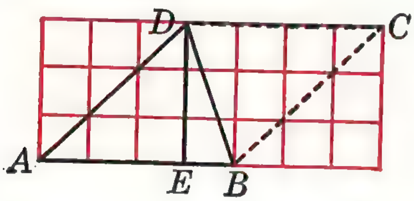
Area of any triangle

1. Shown below is the scale drawing of a triangle with a base b of 4 ft. and a height h of 3 ft. (The height, or altitude, must form a right angle with the base.) Is the area of the triangle 4×3, or 12 sq. ft.?

Scale: The side of one square = 1 ft.



2. If you add to the triangle in Ex. 1 a second triangle just like the irst one in size and shape, the resulting figure is a parallelogram *ABCD*. Try this with two such triangles cut rom cardboard.)

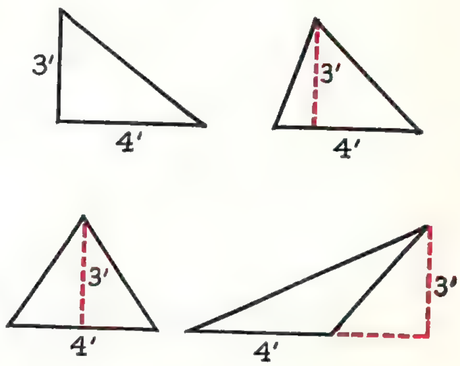


The area of the parallelogram is $\times 3$, or 12 sq. ft. But each triangle $\frac{1}{2}$ of the parallelogram. So the rea of each triangle is $\frac{1}{2} \times 4 \times 3$, or ? sq. ft.

The area of any triangle can be found by multiplying the number of units in the base by the number of units in the height (or altitude) and then taking one half of the product.

$$A = \frac{1}{2}bh$$

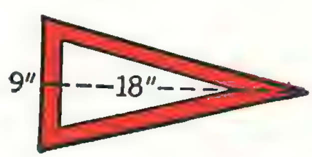
3. What is the area of each triangle below?



Do you see that triangles may have different shapes, but the same area? You should note that in the fourth figure, the height (at right angles to the base) is outside the triangle.

4. The art class made school banners with the dimensions as shown in the diagram below. How many square inches were used in each banner?

Was the area as much as a square foot? Explain.



5. A piece of metal was cut in the shape of a triangle with a base of $7\frac{1}{2}$ inches and a height of $7\frac{1}{2}$ inches. How many square inches were in the surface of the triangular piece?

The acre

The *acre* is a unit of surface measure, like the square inch, square foot, or square yard. It is much larger than any of these units. It contains 43,560 sq. ft. It is much smaller than a square mile.

1. An acre can look like this 

or like this 

or like this 

or even like this 

The shape does not matter. It must contain __?__ sq. ft.

2. John said an acre of land could be a square piece a little less than 209 feet on a side. Was he right? (Compare 209 × 209 with 43,560.)

3. Mr. Adams' farm is small. He thinks he owns a little more than 2 acres. The fields measure about 40,000 square feet. The land around the house and barns is 50,000 square feet. Does Mr. Adams have as much as 2 acres?

4. Tom and Fred measured a rectangular field which they thought was about $\frac{1}{4}$ acre. The field was 200′ long and 60′ wide. How much did the area of this field differ from $\frac{1}{4}$ acre?

5. Bill said that his house was on a lot 60 ft. by 145 ft.

Is Bill's lot less than or more than $\frac{1}{5}$ acre? How much?

6. A square piece of land 1 mile long on each side is 1 square mile of land. 1 square mile contains 640 acres. In many states 1 square mile is called a *section.* $\frac{1}{4}$ square mile contains __?__ acres.

7. Mr. Shaw's land is a square $\frac{1}{2}$ mile on each side. How many acres does it contain? Does Mr. Shaw own $\frac{1}{2}$ section or $\frac{1}{4}$ section? Explain.

8. Everyone should have some idea of the size of an acre of land.

It is easy to see an acre if you live in the country. In a large open field measure off a square 209 feet on a side. If you do not have a tape for measuring, try pacing the distance. For seventh graders that means about 80 to 90 ordinary walking steps.

Mark each corner with a stick or a large stone that you can clearly see from all the other corners. After you have finished measuring the square stand at one edge or at one corner and look at the square so that you have a good notion of the size of an acre.

In the city finding a schoolyard or vacant lot that contains an acre may be more difficult. But you can probably find one that is 100 ft. by 100 ft. or one that is 50 ft. by 100 ft.

The 100 ft. by 100 ft. lot contains nearly $\frac{1}{4}$ acre, and the 50 ft. by 100 ft. lot contains nearly $\frac{1}{8}$ acre. Try to think what a lot would look like with 4 times or 8 times as much area.

Review of areas

Find the area of each of these triangles:

	BASE	HEIGHT	BASE	HEIGHT
1.	3 ft.	5 ft. 6 in.	4 ft.	4 ft. 3 in.
2.	6 in.	5 ft. 4 in.	4 in.	5 ft. 9 in.

Find the areas of rectangles of the following dimensions:

	BASE	HEIGHT	BASE	HEIGHT
3.	8 ft.	9 ft.	9 ft.	3 ft. 2 in.
4.	6 in.	3 in.	4 ft.	8 ft. 6 in.
5.	$9\frac{1}{2}$ ft.	4 ft.	8 ft.	3 in.
6.	9 ft.	6 in.	9 in.	8 ft. 2 in.

7. Find the areas of triangles which have dimensions as listed in Exs. 3–6.

8. A farmer owns a field that is triangular in shape. The base of it is 80 rd. and the height 50 rd. He has been offered $80 an acre for it.

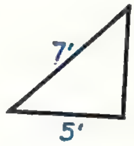
That means he can get $? for the whole field. (160 square rods = 1 acre.)

9. At $3.00 a square yard find the cost of the linoleum needed for a room 10 ft. by 12 ft. 6 in.

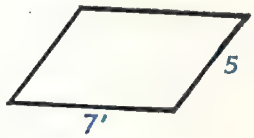
10. The following figures have a base of 2 ft. and a height of 18 in. Find the area of each.

a rectangle	a right triangle
a triangle	a parallelogram

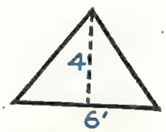
11. Find the area of any of the following figures for which sufficient information is given to enable you to do so.



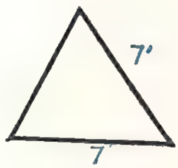
(*a*)



(*b*)



(*c*)



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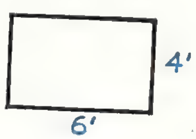

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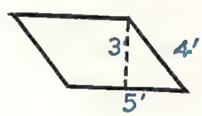

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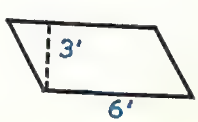

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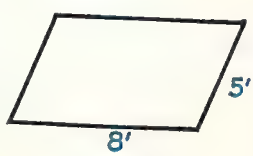

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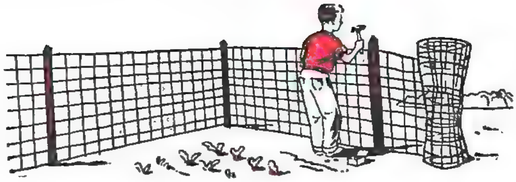
Holding your ground



▶ Oral review

1. 2 is what per cent of 6?

2. Reduce $\frac{18}{24}$ to lowest terms.

3. If $\frac{1}{16}$ in. on a map represents a mile, how long a distance is represented by $1\frac{1}{4}$ in.?

4. If 25% of a number is 20, what is the number?

5. .7 is how many hundredths?

6. Which is larger, $7\frac{3}{4}$ or 7.76?

7. $\frac{3}{4} = \frac{?}{16}$ $\qquad \frac{5}{8} = \frac{?}{16} \qquad \frac{7}{8} = \frac{?}{24}$

8. $6 \times 1\frac{1}{2} = \underline{\ ?\ }$ $\qquad \frac{3}{4}$ of $24 = \underline{\ ?\ }$

9. $2\frac{1}{3} \times 9 = \underline{\ ?\ }$ $\qquad 3 - \frac{1}{4} = \underline{\ ?\ }$

10. $5 \div \frac{1}{2} = \underline{\ ?\ }$ $\qquad 2 \div \frac{1}{6} = \underline{\ ?\ }$

11. $6 \div \frac{1}{3} = \underline{\ ?\ }$ $\qquad 8 \div \frac{2}{3} = \underline{\ ?\ }$

12. Read these numbers: .19, 239.23, 456.298, 599.3004, .002

13. How much is $\frac{1}{10}$ of \$2.50?

14. $4.2 \times 100 = \underline{\ ?\ }$

15. Read these numbers to the nearest hundredth:

54.376	89.073	9.753
27.006	10.087	4.729

16. What per cent is each of the following?

$\frac{1}{8}$	$\frac{3}{5}$	$\frac{5}{8}$	$\frac{1}{4}$	$\frac{2}{3}$
.20	.25	$.12\frac{1}{2}$	.33	.75

17. If you pay \$.80 for a box containing 100 pen points, how much is each pen point costing you?

18. If you need $\frac{1}{2}$ cup of sugar for one custard, how many cups of sugar will you need for 3 custards?

19. How much is 30×8? 40×7? 50×8? 90×7?

20. $\frac{1}{4} + \frac{1}{3} = \underline{\ ?\ }$ $\qquad 2.02 + 3.2 = \underline{\ ?\ }$
$.1 \times .1 = \underline{\ ?\ }$ $\qquad .1 \div .1 = \underline{\ ?\ }$

21. Out of 800 pupils 3% have been absent or tardy. How many is that?

22. What is $33\frac{1}{3}$% of 639?

23. What is $66\frac{2}{3}$% of 24?

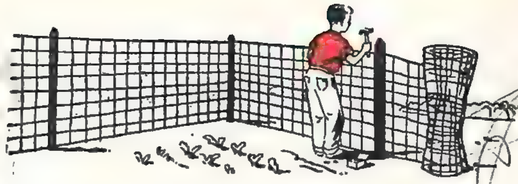
24. Ted bought a fifteen-dollar tennis racket at a discount of 10%. How much did he have to pay for it?

25. Jane had a 9-foot piece of toweling from which she made towels each 2 feet long. How many towels did she make? How much material was left over?

26. When you divide 9 ft. by 2 ft., would you interpret the remainder as $\frac{1}{2}$ ft., 1 ft., or $\frac{1}{9}$ ft.?

27. When three boys share 17 marbles equally, would you interpret the remainder as $\frac{2}{3}$ of a boy, $\frac{2}{3}$ of a marble, or 2 marbles?

Holding your ground



Written review

1. $32\overline{)9944}$ $\quad 2\frac{1}{2} \times 4\frac{1}{4} \times 1\frac{1}{4}$

2. $12\frac{3}{4} \div 4\frac{5}{6}$ $\quad 18\%$ of $60 =$ ___?___

3. ___?___% of $24 = 8$ $\quad$ ___?___% of $48 = 18$

4. Divide 275.84 by .46 and express the quotient to the nearest tenth.

5. Find the perimeter of a rectangle $8\frac{1}{8}''$ by $9\frac{9}{16}''$.

6. Write this number in figures: 5 billion, 703 million, 5 thousand.

7. How many square inches are there in a square foot?

8. Find the area of a rectangle that is $4.5'' \times 3.2''$.

9. Using the formula $A = s^2$, find A when $s = 15$ ft.

10. What is the area of a square $4\frac{3}{4}$ ft. on a side?

11. Add $7\frac{2}{3}$ and $5\frac{5}{6}$.

12. Change $\frac{165}{13}$ to a mixed number.

13. Is $36 \div \frac{3}{8}$ more or less than 36?

14. $8.34 \times .07$ $\quad 20006 - 6007$

15. Find 8% of 432.

16. If 40% of a number is 800, what is the number?

17. From 4 hr. 17 min. take 2 hr. 35 min.

18. 20 is what per cent of 35, to the nearest whole per cent?

19. If a triangle has a right angle and one angle of 35°, how many degrees are there in the third angle?

20. What is the interest on $645 for 3 years at 4%?

21. What is the interest on $250 for 6 months at 6%?

22. What is the interest on $600 for 4 months at 5%?

23. Mr. Wilson, a jeweler, bought a clock for $60. He estimated that his overhead expense was 30% of the cost of his goods.

When he sold the clock for $100, what per cent of the cost was his profit?

24. How much will $40 amount to in 90 days if it is placed on interest at 6%?

25. A shoe dealer bought a pair of shoes for $8.00. He figured that his overhead expense amounted to 20% of the cost of his goods.

For how much must he sell the shoes in order that he may make a profit of 20% of the original cost?

26. 22 seventh-grade girls out of 34 ride to school every day. What per cent is that?

Circumference of a circle

Janet is making a round braided rug. It is all finished except that she wants to sew one row of black braid around it for the border.

Yesterday when she was over at Muriel's home, Muriel said she would give Janet a $3\frac{1}{4}$-yard piece of black braid that she had left from her rug.

Janet said, "I don't know how much is needed. I have measured the diameter and it is one yard.

"But I am not sure what the distance around is."

The children in the illustration below are trying to find the relation between the diameter of a circle and its *circumference* (the distance around).

They measured the diameter of a circular object, such as a plate or a coffee-can cover. Then they placed the object so that it would roll along a straight line AB as shown.

They marked a point X on the plate and placed that point at A on the straight line. Then they rolled the plate along the line until the point X on the plate touched the line again, as at point C.

The distance from A to C is the *circumference* of the circle. They measured the line from A to C.

No matter what the size of the circular object is, you will find that the circumference is a little more than 3 times the diameter. Check this statement by using several plates.

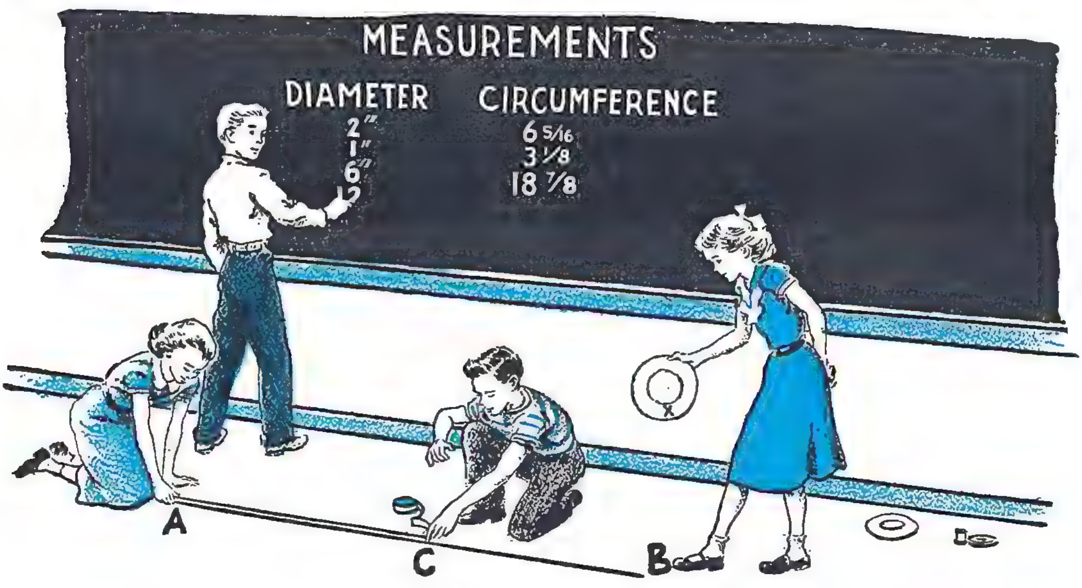
Mathematicians have computed very carefully the ratio of the circumference of a circle to its diameter. It is about $3\frac{1}{7}$ or 3.14, but it never "comes out even."

People generally use the Greek letter π (pi) to represent this ratio.

The circumference of a circle is π times its diameter. The formula is:

$$c = \pi d$$

Use $3\frac{1}{7}$ or 3.14 for π.



Finding circumference

1. The diameter of Janet's rug (page 242) was 1 yd., so the circumference was $3\frac{1}{7}$ yd. Was the $3\frac{1}{4}$-yd. piece of braid that Muriel offered to Janet enough?

2. To find the circumference of a circle whose diameter is 8 in., think:

▶ $c = \pi d$
▶ I know that $d = 8$ in.
▶ So $c = 3.14 \times 8 =$ _?_
▶ The circumference is _?_ in.

3. What is the circumference of a circle if the diameter is 14 in.? (Use $\pi = 3\frac{1}{7}$.)

Find the circumferences of circles whose diameters are the following lengths. (Use $\pi = 3.14$ and give the circumference to the nearest tenth.)

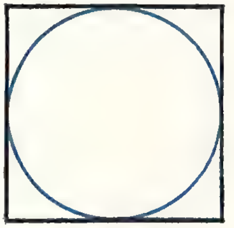
	a	*b*	*c*	*d*
4.	6″	9′	4″	15′
5.	4.5′	5.8′	3.3′	6′ 6″

6. A wheel is 2.8′ in diameter. How far will the center of the wheel travel as the wheel rolls through one complete revolution? (Answer to the nearest tenth.)

7. How many inches of tape are needed to bind the edge of a circular hot-pan holder whose diameter is 6 inches? Allow 1 inch extra for making a seam in the tape.

Give the answer to the nearest quarter of an inch.

8. Mary has 5-inch squares of cloth from which she plans to cut circles. What is the diameter of the largest circle she can cut?



What will be the circumference (to the nearest tenth) of this circle?

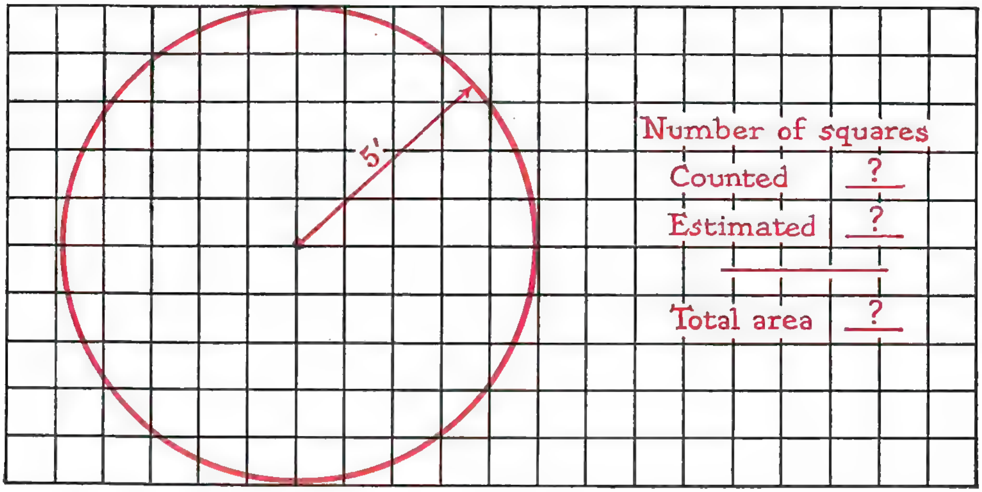
9. The minute hand of a clock is 2 inches long. Will the tip of this hand move as much as 8 yards in 24 hours? How much more or less, in inches?

(Note that 2 inches is the radius, not the diameter.)

10. To protect a tree how many feet of wire fencing are needed to make a circle with a diameter of 10 feet?

11. Bill's father owned a field 145 yards square. Bill wondered if the field was large enough for a 440-yard circular running track. Is the field too short or is it long enough for Bill's track? Explain.

12. The opening for the storm door at Frank's house is 3 feet wide and the top is in the form of a half circle. How much weatherstripping does Frank need to cover the curved part of the door opening?



Area of a circle by counting

Mrs. Glenn telephoned Frank and asked him if he would spade her circular flower garden.

She said, "The garden is 10 feet in diameter and I will pay you 2¢ a square foot or $1.50 for the job, whichever you prefer."

Frank didn't know which payment to choose because he didn't know how many square feet there were in the garden.

He told Mrs. Glenn he'd spade the garden and would let her know before he started which payment he preferred.

Frank remembered that area is the number of square units a surface contains. So he drew a scale drawing of the garden on square-ruled paper.

He let a side of each square represent 1 foot and drew a circle with a 5-foot radius. He counted the squares and estimated the number of whole squares that the part squares would make.

1. Above is shown a circle with a 5-foot radius. (A side of each square represents 1 foot.) What is your estimate of the area?

2. Explain why it is difficult to find the area this way.

3. The radius is 5 ft. Is your estimate of the area more or less than 5×5 (25 sq. ft.)?

4. Is your estimate a little more than 3 times 5^2 (75 sq. ft.)?

5. Should Frank accept the $1.50 or work for 2¢ a square foot? Why?

6. Mathematicians have found that the area of a circle is about $3\frac{1}{7}$ or 3.14 times the square of the radius. This relation is written:

$$A = \pi r^2$$

Use the formula $A = \pi r^2$ to check your estimate of the area in Ex. 1.

Volume

Squares and rectangles are flat, but *cubes* and other rectangular solids (page 221) have length, width, and height. A box of soap chips has six *faces* or *sides*, each of which is a rectangle. It is a rectangular solid.

Ordinarily the length, width, and height in a rectangular solid are all different. In a cube all these dimensions are the same.

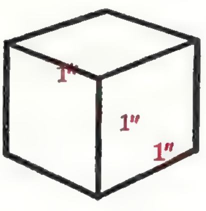
When you find out how much room or space a solid occupies, you are finding the ***volume*** of the solid.

A straight line is measured in linear units (inches, or feet, or yards).

A rectangle is measured in square units (square inches, square feet, etc.).

Any rectangular solid is measured in *cubic units* (cubic inches, cubic feet, etc.).

The block at the right represents a *cubic inch.* A cube 1 in. long, 1 in. wide, and 1 in. high is a ***cubic inch*** (cu. in.).



Other units of volume are the *cubic foot* (cu. ft.) and the *cubic yard* (cu. yd.). Can you describe these units?

1. Try to get some inch cubes and fill a box with them. Then you can see what volume means; that is, the number of cubic inches in the box.

2. Make a model of a cubic foot using stiff cardboard.

3. In the picture below Frank and Helen are looking at a block marked off in 1-inch squares.

Frank says, "The block at the left has length, width, and height."

Helen answers, "Yes. Its length is _?_ in., its width is _?_ in., and its height is _?_ in."

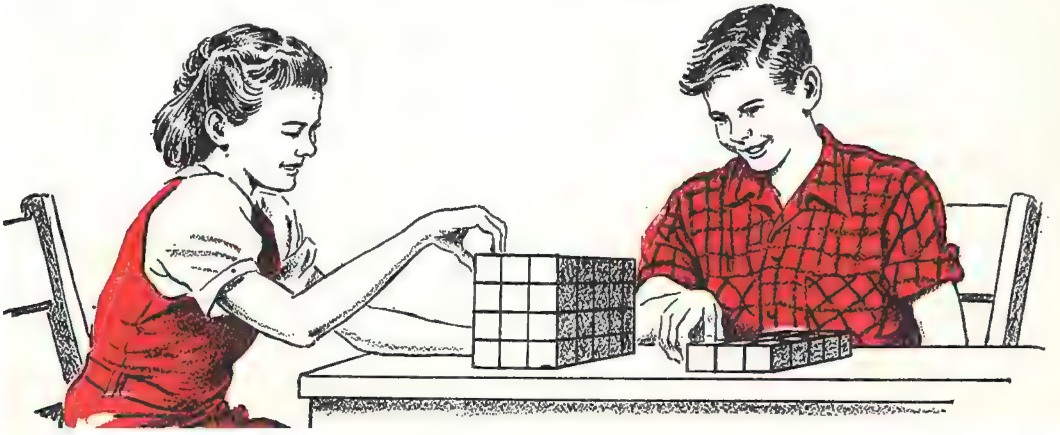
Frank: "What is the other block?"

Helen: "Miss Lewis told me that it represents a one-inch layer of the larger block. This layer is _?_ long, _?_ inches wide and 1 inch high."

Frank: "The layer is $5'' \times 3'' \times 1''$ and so contains 15 cubic inches."

Helen: "Yes. And the large block is 4″ high, so it will contain 4 layers like this or 4×15 or _?_ cu. in.

Frank: "That's right. Do you see an easy way to find the volume of a rectangular solid, when you know the length, width, and height?"



Volume of a rectangular solid

From the discussion on page 245, you have seen that:

The volume of a rectangular solid is equal to the product of the number of units in its length, its width, and its height.

$$V = lwh$$

The dimensions for the length, width, and height must all be in the same kind of units.

1. Does lwh mean $l \times w \times h$ or $l + w + h$?

2. To find the volume of a box (rectangular solid) $6'' \times 3'' \times 2''$, think:

▶ $V = lwh$

▶ I know that $l = 6''$, $w = 3''$, and $h = 2''$.

▶ So $V = 6 \times 3 \times 2 =$ _?_

▶ The volume is 36 cu. in.

3. To fill a hole $9' \times 9' \times 2'$ with earth, you would need _?_ cu. ft. of earth.

4. A pile of wood 8 ft. × 8 ft. × 4 ft. contains _?_ cu. ft. of wood, or _?_ cords of wood. (A cord is 128 cu. ft.)

5. How many cords of wood are there in piles of wood of the following dimensions?

2 ft.×8 ft.×8 ft.	8 ft.×4 ft.×2 ft.
3 ft.×8 ft.×6 ft.	4 ft.×6 ft.×4 ft.
4 ft.×4 ft.×4 ft.	2 ft.×4 ft.×4 ft.

6. Find the volumes of boxes with the following dimensions:

$2''$, $3''$, $5''$	8 ft., 6 ft., 6 in.
$3'$, $4'$, $5'$	9 yd., 3 yd., 2 yd.
$12'$, $4'$, $4\frac{1}{2}'$	9 yd., 3 yd., 2 ft.

7. An aquarium is 15 in. long, 8 in. wide, and 12 in. high. When it is filled to a line 2 in. from the top, it contains _?_ cubic inches of water.

8. The inside of Mr. Young's trailer is 17 ft. long, 7 ft. wide, and 8 ft. high. Its volume is _?_ cu. ft.

9. Mrs. Carr wished to cover a flower bed 12 feet long and 2 feet wide with 6 inches of rich loam. She needed _?_ cubic feet of loam.

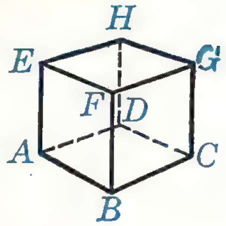
10. Ted has two boxes. He measured the lengths, widths, and heights of the boxes and found that each dimension of the larger box was two times the corresponding dimension of the smaller box.

- If the dimensions of the smaller box are 3 ft. by 2 ft. by 1 ft., the dimensions of the larger box are _?_ ft. by _?_ ft. by _?_ ft.
- Find the volume of each box.
- The volume of the larger box is _?_ times the volume of the smaller.

11. Paul needs a packing box that will hold 5 cubic feet. He found a box $2\frac{1}{4}$ ft. by $1\frac{1}{2}$ ft. by $1\frac{1}{2}$ ft. How much more or less than the needed 5 cubic feet will the box hold?

Volume of a cube

You know that a cube is a rectangular solid in which all the dimensions are equal. The rectangular solid at the right is a cube.



All the *edges* AB, BC, CD, DA, EF, FG, GH, HE, AE, BF, CG, and DH are equal.

1. If each edge of a cube is 5 in., what is its volume?
($V = 5 \times 5 \times 5 =$ _?_ cu. in.)

2. $5 \times 5 \times 5$ can be written 5^3. 5^3 is read *5 cube* or *the cube of 5*.
6^3 means _?_ $\times$ _?_ $\times$ _?_.
s^3 means _?_ $\times$ _?_ $\times$ _?_.

3. $4^3 = 4 \times 4 \times 4 =$ _?_.
$3^3 =$ _?_. $2^3 =$ _?_. $8^3 =$ _?_.

To find the volume of a cube whose edge is s, use the formula

$$V = s^3$$

4. To find the volume of a cube whose edge is 2 in., think:

▶ $V = s^3$
▶ I know that $s = 2$
▶ So $V = 2^3 = 2 \times 2 \times 2 =$ _?_
▶ The volume is 8 cu. in.

5. Find the volume of cubes whose edges are as follows:

3 yd. 4 ft. $1\frac{1}{2}''$ 6.2 ft.

6. How many cubic inches are there in a cubic foot? (Each edge of a cubic foot is 12 in. long. $12 \times 12 \times 12 =$ _?_.)

7. How many cubic feet are there in a cubic yard? (Each edge is 3 feet long.)

8. There are about $7\frac{1}{2}$ gallons in a cubic foot. A cubical tank each of whose edges is 2 ft. will contain about _?_ gallons.

9. John's father works for the city. In the winter he carries sand for sanding streets in a truck with a carrying space $10' \times 5' \times 3'$.

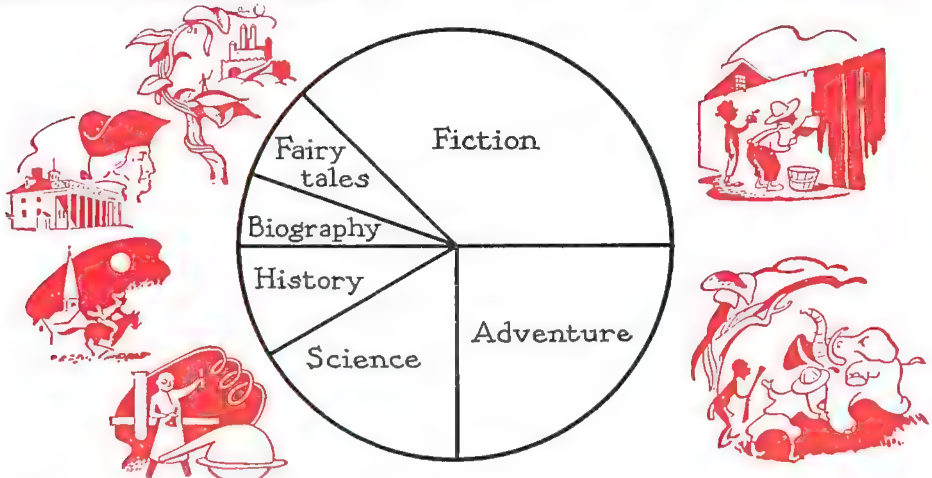
How many cubic yards of sand will the truck hold?

How many truck loads can he get from a cubical storage bin each edge of which is 20 feet?

Copy and complete the following table. Use the formula $V = s^3$.

	s	V	s	V
10.	10 in.	_?_ cu. in.	8 in.	_?_ cu. in.
11.	6 in.	_?_ cu. ft.	1 in.	_?_ cu. ft.
12.	3 ft.	_?_ cu. yd.	6 ft.	_?_ cu. yd.
13.	2 ft.	_?_ cu. in.	$1\frac{1}{2}$ ft.	_?_ cu. in.
14.	$1\frac{1}{2}$ ft.	_?_ cu. ft.	$2\frac{1}{2}$ ft.	_?_ cu. ft.
15.	$\frac{1}{2}$ yd.	_?_ cu. ft.	$\frac{2}{3}$ yd.	_?_ cu. yd.

LIBRARY BOOKS READ IN JANUARY AND FEBRUARY



Reading a circle graph

The illustration above is a *circle graph*. In this case the graph represents the total number of library books read in the Mills School during January and February.

The parts of the circle shaped like pieces of pie are ***sectors***. Each sector shows what part of the total are books on fiction, books on adventure, and so on.

The size of the sector depends upon the size of the ***central angle***, the angle at the center between two radii.

Tell the answers to Exs. 1–5 without measuring the central angles:

1. The books read most often were books on _?_.

2. The books read next often were books on _?_.

3. The books read least often were books on _?_.

4. More science books were read than were books on _?_, _?_, or _?_.

5. As many adventure books were read as were books on _?_ and _?_ together.

6. The central angle for books on adventure is 90° or $\frac{1}{4}$ of all the degrees about the center.

This means that books on adventure made up _?_ of all the books used.

7. Measure the central angle for books on fiction. How many degrees is it? What part of 360° is it?

What part of all the books were books on fiction? What per cent?

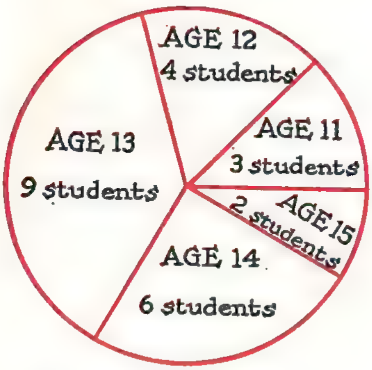
8. If a total of 720 books were read, how many were biographies?

A circle graph is commonly used to show the relation of a part of something to the whole and the relation between the different parts.

How a circle graph is made

A group of seventh-grade students made a circle graph to show what part of the class were in the various age groups.

AGE GROUPS IN SEVENTH GRADE



1. Tell the class what you can learn from the graph shown above.

2. How many students were in the room? The circle represents the whole, or __?__ students.

3. What fractional part of the class were students who were 11 years old? 12 years old? 13 years old? 14 years old? 15 years old?

4. What per cent of the class was in each group? (How do you change $\frac{9}{24}$ to a per cent?) Give the answer to the nearest whole per cent.

5. The 14-year-old students make up $\frac{1}{4}$ of the class. The central angle for the sector representing the 14-year olds is therefore $\frac{1}{4}$ of 360°, or __?__°.

6. The other groups are $\frac{2}{24}$, $\frac{3}{24}$, $\frac{4}{24}$, and $\frac{9}{24}$ of the class. Reduce these fractions to lowest terms.

7. To find out how large a central angle to make for 2 students, find $\frac{2}{24}$ or $\frac{1}{12}$ of 360° = __?__°.

8. How large should the central angles be drawn for 3, 4, and 9 students?

9. You have now seen how this graph was made. Measure the angles with a protractor to see if they check with your work.

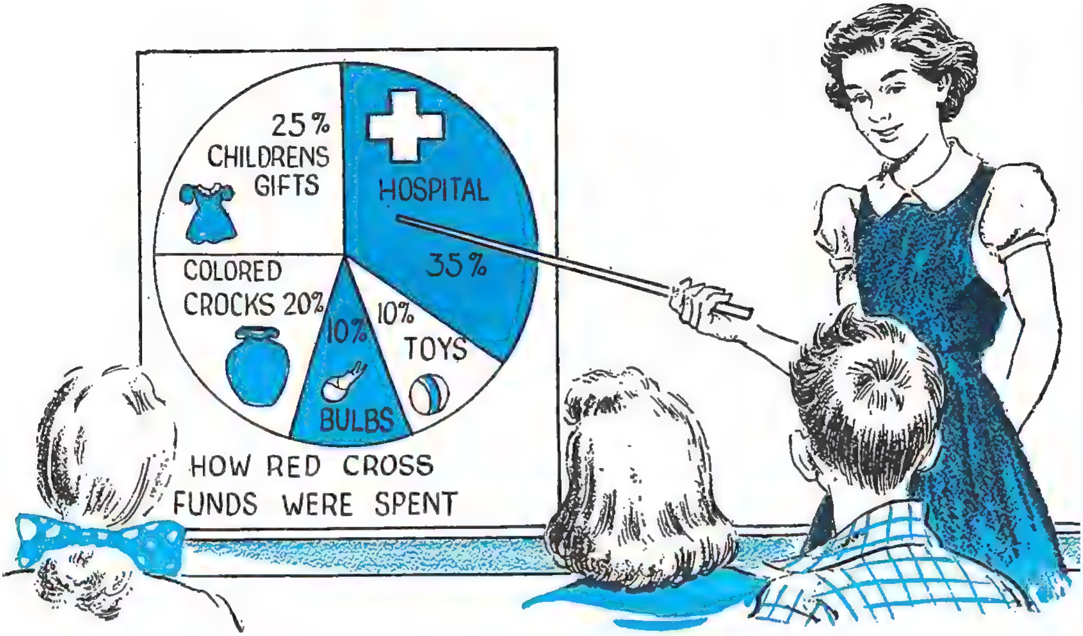
10. Find the following to the nearest degree:

$\frac{1}{11}$ of 360°	$\frac{2}{11}$ of 360°
$\frac{3}{11}$ of 360°	$\frac{5}{11}$ of 360°

11. What is the sum of the fractions in Ex. 10? What is the sum of the angles that you found? Explain your answer.

12. Change each fraction in Ex. 10 to the nearest whole per cent. What is the sum of these per cents? Explain.

13. Using the per cents you found in Ex. 12, find those per cents of 360°. Do your answers agree with those you got in Ex. 10? Explain.



More about circle graphs

Mary Allen, treasurer of the Junior Red Cross Club in Bingham School, made a report in which she showed how the Red Cross funds had been spent.

To illustrate her report she exhibited the circle graph shown above.

1. Tell what you can just by looking at the graph.

2. What is the sum of the per cents indicated on the graph?

The sum of per cents in a circle graph should always be _?_%.

3. The club spent a total of $72 during the year. Of this, 25% went for children's gifts.

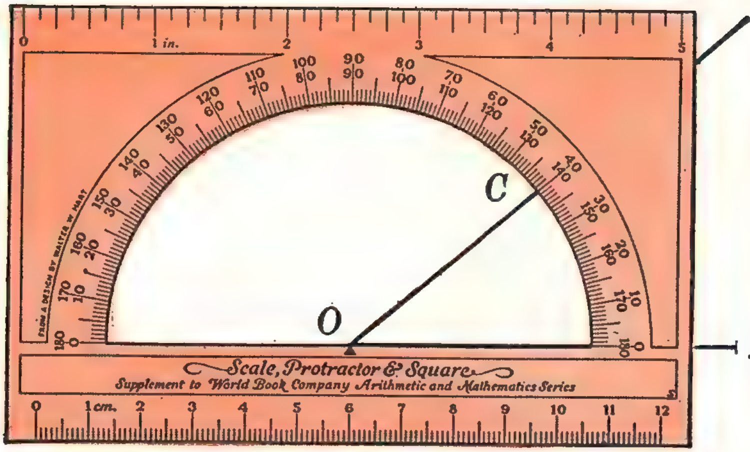
How much went for children's gifts?

4. With your protractor, find the size of each central angle and record your results in a table like the one below.

5. Find the amount spent for each type of service (as you did for one type in Ex. 3), and record that also.

EXPENDITURES	SIZE OF ANGLE	AMOUNT SPENT
Hospital	?	?
Bulbs	?	?
Colored crocks	?	?
Toys	?	?
Children's gifts	?	?

6. Compute the sizes of the angles and check with the measured sizes in the table.



Making angles

1. Draw an angle of 40°. Follow hese directions:

▶ Draw *OB* to form one side of he angle.

▶ Place your protractor as shown bove and put a dot at the 40-degree nark. Call this point *C*.

▶ Lift off the protractor and draw line from *O* through *C*.

▶ The resulting angle *BOC* is 40°.

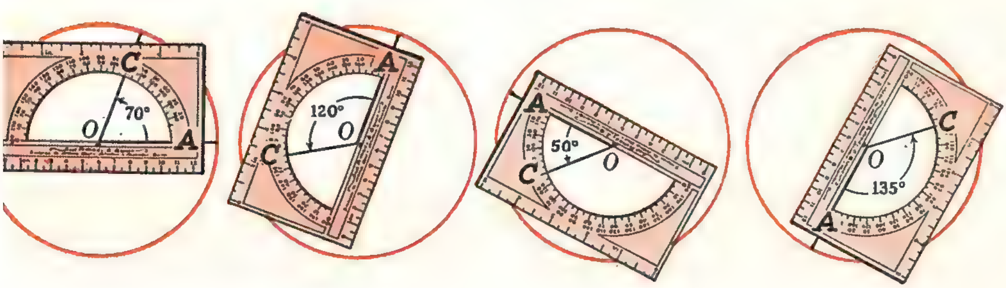
2. Draw angles containing the fol-owing numbers of degrees:

5° 60° 70° 90° 120° 150° 165°

3. The figures below show you how to place your protractor in making central angles of a given number of degrees in a circle.

The line *OA* is in every case the first side of the angle drawn. It is drawn in several different positions because when you make a circle graph, this line may be any radius of the circle.

Draw four circles, each with a 2-inch radius, and in each circle make one of the angles indicated in the following figures.



Making circle graphs

Every month Mr. Sandquist makes a circle graph from the information in his family accounts to show how the family spent its money for that month.

His family consists of Mrs. Sandquist and his 13-year-old daughter. His income (take-home pay) is \$300 a month.

The family expenditures for May (rounded off to the nearest \$5) were as follows:

Food, \$90; Rent and operating expenses, \$90; Clothes, \$45; Recreation, \$30; Savings, \$45.

He first made a table like the one shown at the bottom of the page.

1. Do the various expenditures add to \$300? Check the sum.

2. Explain how each fraction in the third column was obtained.

3. What should be the total of the parts? Explain.

4. Explain how the per cents were obtained.

5. What is the sum of the per cents in the table? Explain.

6. Explain how each central angle was obtained.

7. What is the sum of the angles?

8. Copy the table at the bottom of the page but fill in only the first column and the amount column. Then without looking at the book fill in the other columns.

Check your work when you have finished by looking at the entries in the table.

9. Try to make a circle graph of the data in the table below without looking at the graph on the next page.

- How many central angles will you have?
- How many degrees should there be in each central angle?

	AMOUNT	FRACTIONAL PART OF WHOLE	PER CENT OF WHOLE	CENTRAL ANGLE
Food	\$ 90	$\frac{90}{300} = \frac{3}{10}$	$\frac{3}{10} = \frac{30}{100} = 30\%$	30% of 360° = 108°
Rent and Operating	90	$\frac{3}{10}$	30%	108°
Clothes	45	$\frac{3}{20}$	15%	54°
Recreation	30	$\frac{1}{10}$	10%	36°
Savings	45	$\frac{3}{20}$	15%	54°
Totals	\$?	$\frac{?}{20} =$?	? %	? °

10. Below is Mr. Sandquist's circle graph for the family expenditures during the month of May. Compare his graph with the one you made in Ex. 9. How are they alike? how different?

EXPENDITURES FOR MAY

11. The forest land of the United States covers about 462 million acres. 20% of this is owned by the United States, 5% is owned by the states, and 75% is owned by private citizens.

Make a circle graph to represent these facts.

How many acres are owned by the United States government? by the state governments? by private citizens?

12. For the first four months of school the monthly totals of sales of savings stamps in Prescott School were: September, \$25; October, \$75; November, \$50; December, \$100.

Make a circle graph to show the sales for these four months.

The whole circle will represent \$__?__.

13. The Dalton School sold \$75 worth of tickets for a school play. They paid \$25 for the use of the play, \$15 for expenses for costumes and programs, and had \$35 left to give to the school treasury.

Make a circle graph to show how the \$75 was used.

14. Donald's physician prescribed for him a daily diet consisting of 240 grams of carbohydrate, 110 grams of protein, and 120 grams of fat.

Make a circle graph to show the distribution of these three kinds of food.

15. Mary kept a record of what she did on a typical school day. Here is her record for Tuesday:

Sleeping, 10 hours; eating, $1\frac{1}{2}$ hours; school, $5\frac{1}{2}$ hours; study, 1 hour; play, 5 hours; chores, 1 hour.

Make a circle graph to show how Mary spent the day.

16. In Mr. Smith's class at Chestertown School, all the students were given a copy of the morning paper on Jan. 24. After 10 minutes Mr. Smith asked the students to report what they were reading. The results were as follows:

TOPIC	NO. OF STUDENTS
World news	10
Sports	8
Comics	3
Social news	5
Editorial page	1
Local news	4

Make a circle graph to show these facts.

Review of area and volume

1. Peter's father bought a rectangular piece of land in the country. It was 180 ft. × 240 ft.

Was this more or less than an acre? (An acre is 43,560 sq. ft.)

2. A square piece of land 200 feet on a side contains _?_ square feet less than an acre.

3. How many acres are there in a field 330 ft. × 132 ft.? in a field 165 ft. by 132 ft.?

4. A new school building is to be 220 feet long and 100 feet wide. How many square feet of ground does it cover?

Is this about $\frac{1}{4}$, $\frac{1}{2}$, or $\frac{3}{4}$ of an acre?

5. A kind of candy called Turkish paste is often cut into 1-inch cubes.

How many cubes can be packed in a box 7 inches long, 2 inches wide, and 2 inches high?

6. The directions on a box of moth crystals read: "One box will protect 40 cubic feet."

If Mary's clothes closet is 2 ft. × 4 ft. × 8 ft., will she need 1 box, 2 boxes, or 3 boxes to protect her clothes against moths?

7. A builder told Mr. Wood that a new flat-top garage of cinder block would cost about 90¢ for each cubic foot of space that the garage occupies.

Estimate the probable cost of building a garage 20′ × 20′ × 9′.

8. Jim is making a coal bin in the cellar. It is 8 feet long and 3 feet 6 inches wide, and can be filled to a depth of 5 feet.

How many cubic feet will it hold?

How many tons of hard coal will the bin hold? (1 ton = 35 cubic feet.)

9. Find the number of cubic feet of storage space in a deep freezer 2′ × 2′ × $1\frac{1}{2}$′.

10. A freezer with dimensions of 2′ × 2′ × $4\frac{1}{2}$′ sells for $249 and one with dimensions of $2\frac{1}{2}$′ × $2\frac{1}{2}$′ × 4′ sells for $289.

What is the difference in cost per cubic foot?

11. A gallon of gasoline takes up 231 cu. in. of space. A can for carrying extra gasoline measures 10″ × 10″ × 20″.

How many gallons will this can hold (to the nearest gallon)?

12. One solid block of wood is 1 foot long, 1 foot wide, and 1 foot high. Its volume is _?_ cu. ft.

Another block is $\frac{1}{2}$ foot long, $\frac{1}{2}$ foot wide, and $\frac{1}{2}$ foot high. What part of a cubic foot is its volume?

13. Mr. Todd wants a strong box for his valuables. He can get one that measures $12\frac{1}{2}$″ × 9″ × 3″ or another that measures $10\frac{1}{2}$″ × 8″ × 4″.

Which is the larger box? How much larger is it?

Problem analysis

In each of the following problems tell (1) *what you want to find,* (2) *what you must do to find it, and* (3) *what you must find first. Then solve the problem. The first three are analyzed for you.*

1. What is the cost of cementing a floor 16 yd. long and 12 yd. wide at $3.00 per square yard? Think:

▶ I want to find the total cost.

▶ I must multiply the cost per square yard by the number of square yards.

▶ I must first find the number of square yards.

2. George traveled 987 miles on 70 gallons of gasoline. At 27.4 cents per gallon, what was the average cost per mile (to the nearest cent)? Think:

▶ I want to find the average cost per mile.

▶ I must divide the total cost by the number of miles.

▶ I must first find the total cost.

3. A truck will hold $2\frac{1}{2}$ tons. How many castings weighing 250 pounds each can be loaded on it? Think:

▶ I want to find how many castings can be loaded on the truck.

▶ I must divide the number of pounds the truck can hold by the number of pounds in 1 casting.

▶ I must first find the number of pounds in $2\frac{1}{2}$ tons.

4. While a motorist used up 10 gallons of gas, his speedometer moved from 19284 to 19439. How many miles to the gallon did he get?

5. A train leaves New York at 2:45 P.M. (Eastern time) and arrives at Chicago at 9:45 A.M. (Central time).

At what average rate does the train cover the 909 miles?

6. I paid 90 cents for a dozen oranges and found that 3 of them were spoiled.

I figure that each good orange cost me _?_ cents.

7. Of the 136 boys in our school, 85 can swim. Of the 121 girls, 65 can swim.

Is the per cent of boys who can swim larger or smaller than the per cent of girls who can swim? How much?

8. If an airplane can travel 600 miles in $2\frac{1}{2}$ hours, how long will it take to go 1080 miles?

9. Mr. Case wants to build a swimming pool $20' \times 10' \times 5'$.

How many cubic feet of earth will he need to excavate? How many cubic yards?

10. A tennis court is 69 ft. by 36 ft. If the playing surface is made 8 in. deep, how many cubic feet of surface material is needed?

Be your own teacher

Think these problems through without the help of a teacher.

1. What is the smallest possible whole number that, when rounded to billions, will be 5 billion? What is the largest possible whole number?

2. Is the value of the 6 in 6734 twice as great as the value of the 3, or 20 times as great, or 200 times as great?

3. Is the value of the 4 in 8734 $\frac{1}{2}$, $\frac{1}{20}$, $\frac{1}{200}$, or $\frac{1}{2000}$ of the value of the 8?

4. Which of these divisions have the same quotients?

$4\overline{)120}$ $\quad 40\overline{)1200}$ $\quad .4\overline{)12}$ $\quad 400\overline{)1200}$

5. Does dropping one of two zeros from a number always divide that number by 10?

6. Which of these products are equal? (Do not multiply.)

$$\begin{array}{r}327\\ \times 250\\ \hline\end{array} \qquad \begin{array}{r}3270\\ \times 25\\ \hline\end{array} \qquad \begin{array}{r}32.7\\ \times 2500\\ \hline\end{array}$$

7. Does annexing a zero to the number 25 increase the number by 10 or multiply it by 10?

8. If each of the addends in the box at the right is multiplied by 10, will the sum be multiplied by 4, by 40, or by 10?

$$\boxed{\begin{array}{r}24\\17\\15\\10\\ \hline\end{array}}$$

9. What principle is illustrated by these divisions?

$.5\overline{)32.5}$ $\quad 5\overline{)325}$ $\quad 50\overline{)3250}$

10. What operation would you use to find the number of small groups of a given size that can be made from a large group? Illustrate.

11. What operation would you use to find the size of each of a certain number of groups that can be made from a large group? Illustrate.

12. If the multiplier is larger than 1, will the product be larger than 1? Illustrate.

13. If the divisor is smaller than 1, will the quotient be larger than the dividend? Illustrate.

Which of these examples illustrate finding (1) a part of a number, (2) what part one number is of another, and (3) a number when a part of it is known?

	a	*b*
14.	$\frac{3}{5}$ of 20 = ?	5% of 80 = ?
15.	.25 of 32 = ?	18 is $\frac{3}{4}$ of ?
16.	27 is ? of 36	$\frac{3}{8}$ is ? % of $\frac{1}{2}$
17.	8 is 25% of ?	$\frac{1}{3}$ is $\frac{1}{2}$ of ?
18.	24 is ? % of 8	9 is $\frac{?}{4}$ of 12
19.	2% of ? is 40	$\frac{3}{4}$ is ? of $\frac{7}{8}$
20.	\$3 is $\frac{2}{3}$ of \$?	60% of $\frac{3}{5}$ is ?

No pencils, please!

Tell whether the statements on this page are true or false.

1. .1 inch is 10 times .01 inch.

2. .001 mile is 10 times .01 mile.

3. It takes five of these .01 miles to make $\frac{1}{2}$ mile.

4. $\frac{.10}{.01}$ is larger than 1.

5. $\frac{1}{10}$ of 1.1 is 1.01

6. .5 mile is more than 2600 feet.

7. .01 mile is about 50 feet.

8. .001 mile is about 5 feet.

9. $\frac{1.2}{.2} = .2\overline{)1.2} = 2\overline{)12} = 6.$

10. $\frac{1.1}{.01} = .01\overline{)1.1} = 1\overline{)110} = 110.$

11. $\frac{.1}{2}$ is $\frac{1}{2}$ of .1 or .05

12. $\frac{3.6}{1.7}$ is more than 20.

13. 4.9×8.1 is closer to 40 than to 50.

14. .01 of 2480 is about 25.

15. $6.1 \div .02$ is more than 300.

16. $.1 \times .1 \times .1$ is .003

17. 2.4 is $\frac{1}{10}$ of 24.

18. $\frac{1}{100}$ of 865 is 86.5

19. 750 times .01 is 7.50

20. 50 times .02 ft. = 1 ft.

21. $\frac{1}{2}$ of .05 mile is .025 mile.

22. $\frac{1}{5}$ of 4.00 feet is .08 feet.

23. $1.2 \times .8$ yard = 1.80 yards.

24. $2.4 - .4 = 2.0$

25. $\frac{1}{7}$ is between .14 and .15

$$\boxed{\begin{array}{r} .1428 \\ 7\overline{)1.0000} \end{array}}$$

26. $\frac{1}{7}$ is between .142 and .143

27. $\frac{1}{7}$ is between .1428 and .1429

28. $\frac{1}{7}$ to the nearest tenth is .1

29. $\frac{1}{7}$ to the nearest hundredth is .14

30. $\frac{1}{7}$ to the nearest thousandth is .143

31. 1 hit out of 7 times at bat is about as good as 14 hits out of 100 times at bat.

32. A baseball batter who hits 1 time out of 7 times at bat has a batting average of .142.

33. Joe got 7 hits out of 36 times at bat. His batting average was better than .200.

34. Tom got 8 hits out of 39 times at bat. His batting average was better than .200.

35. A square field .1 mile on a side contains more than .1 of a square mile of area.

eview problems

1. Find the cost of 8 towels which sell at \$15 a dozen.

2. Which is cheaper, to buy paper napkins at \$.80 a hundred or at \$1.10 a gross?

3. It took Ruth and her father $7\frac{1}{2}$ hr. to drive 300 miles. Find their average rate of driving.

4. At 4 for a quarter, how many oranges can you buy for 50¢? for \$1.00? for \$1.50? for \$2.00?

5. Find the cost of gasoline used in driving 110 miles under the following conditions:

The car used on the average a gallon every 20 miles. The price of the gasoline was 26¢ per gallon.

6. The cost of a yearly subscription for a certain monthly magazine is \$5.00.

Does each issue of the magazine cost about 41¢ or about 42¢?

7. The Smith milk bill in August was \$13.00. Find the average daily cost of the milk.

8. The weight of each of the 5 players on a basketball team was 108 lb., 112 lb., 96 lb., 120 lb., and 115 lb.

The total weight of the players was ___?___ pounds.

The average weight of the players was ___?___ pounds.

9. Betsy's mother bought an electric refrigerator for \$249.50. She paid \$25.00 down and is to pay \$5.00 each week until it is paid for.

How many weekly payments will she have to make? How large will the last payment be?

10. Mr. Harrison bought a lawn mower for \$29.75, a stepladder for \$12.50, and 3 benches at \$14.75 each.

He paid for his purchases with 4 twenty-dollar bills and a ten-dollar bill. He got ___?___ in change.

11. Find the total cost of a $5\frac{3}{4}$-lb. stewing chicken at 49 cents a pound, $1\frac{1}{2}$ doz. eggs at 79 cents a dozen, and 5 lb. of sugar at $9\frac{1}{2}$¢ a pound.

12. During their two weeks' vacation in the mountains last summer, the Kilpatrick family spent \$17.49 for gasoline and oil, \$139.50 for board and room, and \$18.47 for various incidentals.

Find the average daily cost of the vacation.

13. One day Helen's chickens laid 80 eggs. At 80 cents a dozen, the eggs were worth ___?___.

14. Mary has a piece of rubber $22\frac{3}{8}$ inches long. She wants to cut it into pieces each $3\frac{1}{2}$ inches long.

How many such pieces can she get? How many inches of rubber will be left over?

15. Dorothy bought a dress pattern that called for $3\frac{1}{8}$ yd. of material. Then she saw a remnant of silk that she liked, containing $2\frac{7}{8}$ yd.

She thought, "I would take that piece, but it is __?__ yd. less than the pattern calls for."

16. Find the perimeter of a rectangle that is $5\frac{7}{8}$ in. long and $4\frac{3}{4}$ in. wide.

17. According to the chart in the school health office, Harry figured that a boy of his height should weigh 72 lb. He weighed only $69\frac{3}{4}$ lb.

He thought, "I guess I am __?__ pounds underweight."

18. Harry's twin brother weighed $67\frac{1}{4}$ pounds. He was __?__ pounds underweight.

19. Alice paid $3.74 for a $4\frac{1}{4}$-pound piece of ham. The ham must have been selling for __?__ per pound.

20. Tom bought a $5\frac{1}{2}$-lb. chicken for 49 cents a pound. After the chicken was cleaned and ready to cook, it weighed only $3\frac{3}{4}$ lb.

He was paying __?__ cents a pound for the dressed chicken.

21. How many 2-ounce servings of meat are there in a $4\frac{3}{4}$-pound piece? At 80 cents a pound, each serving costs __?__ cents.

22. How much will Bill have to pay for a 2-dollar bicycle horn that is reduced in price by 15%?

23. Mary has a cake recipe which calls for $\frac{3}{4}$ cup of butter and $\frac{3}{8}$ cup of milk. Mary wants to make only $\frac{2}{3}$ of the amount of cake the recipe calls for.

What part of a cup of butter should she use? What part of a cup of milk?

24. Find the total cost of $3\frac{1}{8}$ lb. of bacon at 67¢ a pound, $2\frac{3}{4}$ lb. of butter at 79¢ a pound, $3\frac{7}{8}$ lb. of prunes at 39¢ a pound, and $3\frac{1}{2}$ doz. rolls at 35¢ a dozen.

25. From an 8-yard piece of ribbon, how many pieces each $5\frac{1}{2}$ inches long could you cut?

26. George bought 2 guinea pigs for 75¢ each and sold them for $1.00 each. During the time he kept the pigs their food cost him $1.30. Also he spent about 6 hours caring for them. He thought that his time was worth 50¢ an hour.

What per cent of the total cost of the pigs did George gain or lose when he sold them?

27. Dolores picks raspberries for her uncle at 6¢ a basket. She averages about 54 baskets during a 6-hour day. What is her average pay per hour?

28. Agnes left for the beach with $2.50. The bus fare each way was 29¢ and the locker fee was 44¢.

If she spent 15¢ for a hot dog and 12¢ for orange juice, how much money did she have left?

Problems and practice

1. The popcorn committee made $3\frac{3}{4}$ pounds of popcorn to sell at the school carnival. The popcorn will be sold in bags each holding 3 oz., at 10 cents a bag.

How much money will the committee take in if all the bags are sold?

2. How many lines would have to be drawn on a sheet of blank paper 6 inches wide, to divide it into columns each $\frac{3}{8}$ of an inch wide?

3. An automobile party started on a 240-mile trip at 8:30 A.M.

If the party averages 30 miles an hour and takes 45 minutes out for lunch and rest, at what time in the afternoon will the trip be completed?

4. At the start of an automobile trip the speedometer registered 1986.7 mi. When the trip was completed, the speedometer registered 2798.9 mi.

Fifty-four gallons of gasoline had been used. On the average, the car traveled _?_ miles on a gallon.

5. At $1.75 a bushel, what is the cost of $8\frac{1}{2}$ bushels of apples?

6. As treasurer of the seventh-grade class, Elizabeth collected $1.35 from each of the 32 pupils in the class.

When she turned over the money to the class adviser, she had only $41.85. How much "short" was she?

7. At a sale a piece of chintz containing $5\frac{1}{2}$ yd. sold for $4.68. How much per yard was that?

8. Would you prefer to work for $15 a week or for $62 a month? In a year, the difference would be $_?_.

9. A merchant paid $4.50 a gross for pencils and sold them for 5 cents each.

What was his margin on each pencil (the difference between selling price and cost)?

10. Leo wanted to buy some watermelon seeds to plant. He noticed in a seed catalogue that the seeds sold for 30 cents an ounce or 85 cents for $\frac{1}{4}$ pound.

He thought, "If I could use $\frac{1}{4}$ pound, I could get it for only _?_ cents an ounce."

11. Margaret wants a sweater which costs $5.98. She can save 60 cents a week. How many weeks will it take her to save enough to buy the sweater?

12. Ed mows Mr. Bosworth's lawn every Saturday for $2.00. With Mr. Bosworth's hand mower he can complete the entire lawn in about 3 hours.

If Ed rents a power mower at $1.00 an hour, he can finish Mr. Bosworth's lawn in $1\frac{1}{2}$ hours.

Which method of mowing would you recommend? Explain.

13. Which is the better buy, 6 pounds of green beans at 2 pounds for 27¢ or 6 pounds at 3 pounds for 39¢? Explain your answer.

Holding your ground

▶ Oral review

1. Find: $\frac{2}{3}$ of 18 75% of 24

2. Reduce to lowest terms:

$\frac{6}{8}$ $\frac{4}{6}$ $\frac{5}{10}$ $\frac{6}{16}$ $\frac{4}{16}$ $\frac{4}{12}$ $\frac{14}{16}$

3. If $\frac{1}{8}$ in. represents a mile on a map, what would represent 16 miles?

4. What number is one more than 999,999?

5. Divide:

$7\overline{)63}$ $7\overline{)57}$ $7\overline{)40}$ $7\overline{)66}$

$7\overline{)51}$ $7\overline{)46}$ $7\overline{)20}$ $7\overline{)34}$

6. Tell the missing numerators:

$\frac{2}{3} = \frac{?}{6}$ $\frac{3}{4} = \frac{?}{8}$ $\frac{3}{5} = \frac{?}{10}$

$\frac{2}{3} = \frac{?}{12}$ $\frac{7}{8} = \frac{?}{24}$ $\frac{5}{6} = \frac{?}{18}$

7. $5 = \frac{?}{2}$ $4 = \frac{?}{3}$ $8 = \frac{?}{5}$

$10 = \frac{?}{4}$ $7 = \frac{?}{6}$ $3 = \frac{?}{8}$

8. $7\frac{1}{3} = 6\frac{?}{3}$ $9\frac{3}{8} = 8\frac{?}{8}$ $5\frac{1}{4} = 4\frac{?}{4}$

$12\frac{3}{7} = 11\frac{?}{7}$ $6\frac{3}{4} = 5\frac{?}{4}$ $8\frac{2}{3} = 7\frac{?}{3}$

9. Change to mixed numbers:

$\frac{7}{5}$ $\frac{10}{8}$ $\frac{5}{4}$ $\frac{12}{5}$ $\frac{9}{8}$

10. Four inches is what part of a oot?

11. Nine inches is what part of a oot?

12. When you count by tenths, hat number comes next after 5.9?

13. Tell which is larger:

3 or .7 .40 or 37 .6 or $\frac{1}{2}$

$\frac{3}{4}$ or .73 .07 or .6 $\frac{7}{8}$ or .78

14. If 3% of a square is shaded, what per cent of the square is not shaded?

15. Express as per cents:

.7 $\frac{3}{4}$ .37 $\frac{1}{8}$ 1.00 4

16. Express as decimals:

6% 70% 92% 100% 2.5%

17. 7 is what part of 14? 7 is what per cent of 14?

18. How many sides has a triangle? a square? a rectangle? a hexagon?

19. What is the plural of *radius?*

20. What is the value of 8^2?

21. What is the sum of .9, .8, .7, .6, and .1?

22. If grapefruit are selling at 3 for 50 cents, what will 2 dozen cost?

23. How much is 3^3?

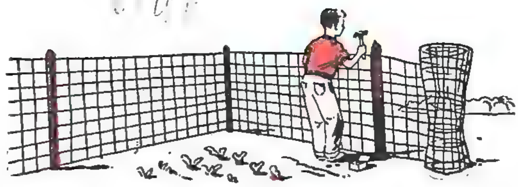
24. Which is larger, 2^3 or 3^2? How much larger?

25. Is 4^2 larger or smaller than 2×4? How much?

26. Is $(\frac{1}{2})^2$ larger or smaller than $\frac{1}{2}$?

27. Compare 1^2 with 1.

Holding your ground



▶Written review

1. Find the sum:

72224 + 19584 + 72653 + 70143

2. Take 7817 from 82253.

3. There are 5280 ft. in a mile. Boys on the track team who run the quarter-mile dash run __?__ feet.

4. Add: 28 ft. 4 in., 16 ft. 2 in., and 26 ft. 10 in.

5. Multiply:

4231	6845	9713	8169
7	6	9	8

6. Subtract 162,479 from 250,001.

7. Divide 595,765 by 85.

8. Find the sum:

$7\frac{1}{4} + 13\frac{2}{3} + 25\frac{1}{2} + 16\frac{3}{4}$

9. Write as decimals:

$\frac{7}{10}$	$\frac{5}{100}$	$\frac{1}{2}$	$1\frac{3}{10}$	$\frac{45}{100}$
$\frac{1}{4}$	$\frac{3}{4}$	$7\frac{1}{2}$	$9\frac{73}{100}$	$7\frac{19}{100}$

10. Write the decimals below as fractions or mixed numbers. Reduce all fractions to lowest terms.

.03	.09	.10	.20	.25
.43	.50	.75	3.07	5.23

11. $2.34 \times 5.2 =$ __?__ $6.3 \div .35 =$ __?__

12. Find: 45% of 36 $2\frac{1}{2}$% of 38

13. 19 is what per cent of 23? Give your answer to the nearest whole per cent.

14. From a piece of bacon weighing 6 lb. 5 oz., a butcher sold $2\frac{1}{2}$ lb. How many pounds and ounces were left on the piece?

15. Find the average of 893.7, 896.6, 898.5, 899.7, and 893.0.

16. What is the difference between .3995 and .4481?

17. If you bisect a line $2\frac{3}{4}''$ long, how long will each part be?

18. What is the area of a rectangle $3\frac{1}{2}''$ by $2\frac{1}{2}''$?

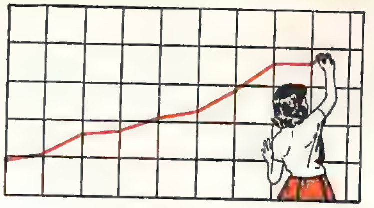
19. Wallace and his father drove 349 miles in $6\frac{3}{4}$ hours. What was their average rate per hour? (Express your answer to the nearest whole number.)

20. What is the interest on $842 at 4% for 6 years?

21. The butcher weighed a piece of meat for Mrs. Vintors. He said, "There are $2\frac{3}{4}$ pounds here. That will be $1.79."

How much was Mrs. Vintors paying per pound for the meat?

22. What is the circumference of a circle whose diameter is 4''?



Measuring your growth in arithmetic

Test 9a

1. If 8 angles about the center of a circle are equal, how many degrees are there in each angle?

2. What is the perimeter in feet of a rectangle 2 feet by 9 inches?

3. The sides of a right angle in a triangle are 3″ and 4″. Find the area.

4. What is the area of a rectangle with base 8″ and altitude $2\frac{1}{2}$″?

5. If the altitude of a rectangle is 4 in. and its area is 20 sq. in, how long is the base?

6. What is the area of a parallelogram with base 8″ and altitude 3″?

7. The sides of a parallelogram are 6 ft. and 8 ft. Its altitude drawn to the 8-foot base is 5 ft. What is its area?

8. The diameter of a circle is 8 in. Find the circumference of the circle.

9. Find the area of a triangle with base 8 ft. and altitude 3 ft.

10. What is s^2 when $s = 5\frac{1}{2}$?

Test 9b

1. Mr. Ward can buy wall board at 23¢ a square foot. How much will wall board cost for a 24′ × 8′ wall?

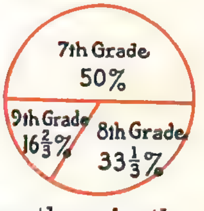
2. The diameter of a wheel is 2.8″. If A is a point on the rim of the wheel, how many inches does A travel when the wheel turns around once?

3. Some giant redwood trees have a diameter of 12 ft. at a distance of 5 ft. from the ground.
What is the distance around one of these trees at this height?

4. Find the number of acres in a rectangular field 32 rd. by 50 rd.

5. If c in $c = \pi d$ is 100, d is __?__.

6. This circle graph shows how the 570 students in Morris School are divided by grades. How many students are there in the seventh grade?



7. How many students (Ex. 6) are there in the eighth grade?

8. How many students (Ex. 6) are there in the ninth grade?

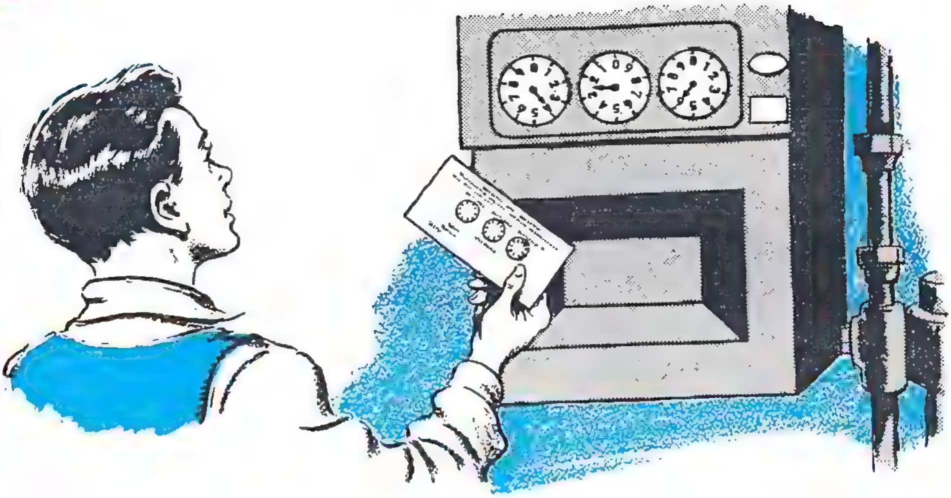
9. A box 3″ × 4″ × 8″ contains __?__ cu. in.

10. Mrs. Ward bought a sun mat for the yard. It is a square 80″ on a side. It covers __?__ sq. ft.

UNIT 18

Reading meters and checking bills

Optional



Reading your gas meter

Jim North came home from school one day and found a card from the gas company placed under the screen door. The card looked like the one illustrated below.

Jim had learned how to read a gas meter and so he made out the card as directed and put the card in the mailbox on the corner. Can you read the meter in the picture?

SPRINGFIELD GAS LIGHT COMPANY

Please mark on the dials below the position of the hands on your gas meter dials and mail this card to us.

10 THOUSANDS THOUSANDS HUNDREDS

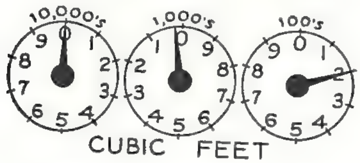
CUBIC FEET

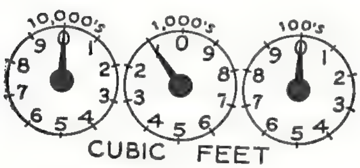
NAME J. R. North

ADDRESS 17 Maple Street

Date of reading Oct 17, Meter No. 23A-2060

1. Gas is measured in cubic feet. The meter dials shown below tell how many cubic feet have been used. Note that the hand on the first dial (counting from the left) turns *clockwise,* the hand on the middle dial turns *counter-clockwise,* and the hand on the third dial turns __?__.





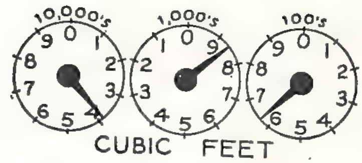
2. The third dial counts by hundreds. The top row of dials shows that __?__ hundred cubic feet of gas have been used.

3. When the hand on the third dial has gone around once, it will again point to zero, but the hand on the middle dial will point to 1.

The middle dial in the bottom row now reads 1, meaning 1 thousand, or __?__ hundred cubic feet.

4. Now turn back to the picture of the meter on page 264. The dials read 426 hundred (426 00). Explain that reading.

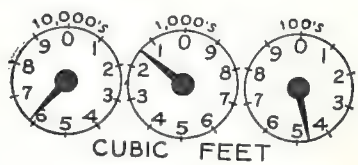
5. In reading a gas meter dial, always read the smaller number if the hand is between two numbers. Can you tell why you should always read the smaller number?



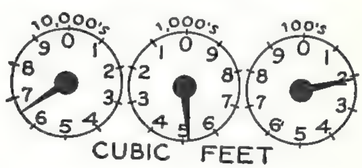
6. The dials above read __?__, meaning __?__ hundred cubic feet of gas have been used.

7. Bring to class a picture of the way the dials on your gas meter look today. Have your classmates give a reading of your meter.

8. Below are shown the gas-meter dials in Frank Merrill's house on March 7. The reading is __?__ hundred cubic feet.



9. Below are shown the same dials (Ex. 8) on April 7. The reading is __?__ hundred cubic feet.



10. How many hundred cubic feet were used from March 7 to April 7?

652 00
614 00
?

11. If a meter read 391 hundred cubic feet on July 24 and 424 hundred cubic feet on Sept. 1, how many hundred cubic feet were used during that time?

Checking your gas bill

This is the way a gas bill looks in Springfield.

SPRINGFIELD *Gas* LIGHT COMPANY

DATE OF BILL OCT. 7, 19—
DISCOUNT DATE OCT. 28, 19—

Date of Previous Reading	METER READINGS PRESENT	METER READINGS PREVIOUS	100 Cu. Ft. Used	1st 100 Cu. Ft. $1.10 Next 900 @ 16c	100 Cu. Ft. @ 12c per 100	100 Cu. Ft. @ 8c per 100		GROSS BILL	NET BILL
SEP 8	59	44	15	10	5			3.14	2.98

H. C. WILSON
24 WESTERN AVE.
C I T Y 328-2140

This bill may be paid at our APPLIANCE STORES, *37 Hillcroft Street*

1. The date of the bill is __?__.

2. The meter was read previously on __?__.

3. This is a bill for gas used from __?__ to __?__.

4. The present reading of the meter is __?__ hundred cubic feet.

5. The previous reading was __?__ hundred cubic feet.

6. The rates published by the gas company are shown below. Check this statement with the rates given on the bill.

MONTHLY RATE

First	100 cu. ft. or less	$1.10
Next	900 cu. ft.	@ 16¢
Next	1,000 cu. ft.	@ 12¢
Next	8,000 cu. ft.	@ 8¢
Over	10,000 cu. ft.	@ $7\frac{1}{2}$¢

7. The bill states that __?__ hundred cubic feet were used. Check the correctness of this statement.

8. The total bill, or gross bill, is __?__.

9. The bill was figured in 3 steps.

Step 1.	100 cubic feet	$1.10
Step 2.	900 cubic feet @ 16¢ a hundred	__?__
Step 3.	500 cubic feet @ 12¢ a hundred	__?__
	Gross bill	__?__

Does your total check with the gas company's total?

10. If the bill is paid by October 28, a discount is given. The net bill is __?__. The amount of discount is __?__.

SPRINGFIELD *Gas* LIGHT COMPANY

DATE OF BILL OCT. 7, 19__
DISCOUNT DATE OCT. 28, 19__

Date of Previous Reading	Meter Readings: Present	Meter Readings: Previous	100 Cu. Ft. Used	1st 100 Cu. Ft. $1.10 Next 900 @ 16c.	100 Cu. Ft. @ 12c per 100	100 Cu. Ft. @ 8c per 100		Gross Bill	Net Bill
SEP 2	426	404	22	10	10	2		3.90	3.70

FRANK W. OWEN
16 HIGHLAND ST
C I T Y

770-1020

This bill may be paid at our APPLIANCE STORES, *37 Hillcraft Street*

11. Study the gas bill above.

What are the gross and net amounts of the bill?
What are the two readings in cubic feet?
Use the readings to check the amount of gas used.
Explain how the gross bill was obtained.
How much is the discount for prompt payment?
What is the rate of discount?

Using the rates given in Ex. 6 on page 266 and a discount of 5%, copy and complete the table below:

	Meter Readings: Present	Meter Readings: Previous	Total 100 Cu. Ft. Used	1st 100 Cu. Ft. $1.10 Next 900 @ 16¢	Number of 100 Cu. Ft. @ 12¢ per 100	Number of 100 Cu. Ft. @ 8¢ per 100	Gross Bill	Net Bill
12.	63	51	12	10	2	?	2.78	2.64
13.	329	304	25	10	10	5	4.14	?
14.	197	121	?	?	?	?	?	?
15.	433	?	33	?	?	?	?	?
16.	75	69	?	6	?	?	?	?
17.	?	167	17	?	?	?	?	?
18.	227	186	?	?	?	?	?	?
19.	?	642	65	?	?	?	?	?
20.	936	?	97	?	?	?	?	?

What electricity does for us

Heats blanket 240 hours for 50¢.

Runs clock 30 days for 4¢.

Runs toaster 3 hr. for 6¢. Runs percolator 7 hr. for 3¢.

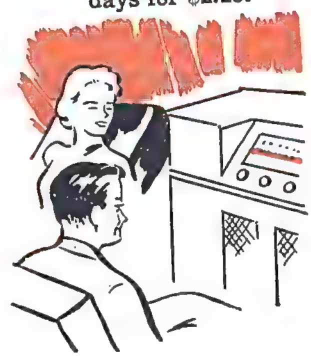
Runs ironer 18 hours for 65¢.

Runs vacuum cleaner 4 hr. for 2¢.

Runs cooking stove 30 days for $2.25.

Runs dishwasher 30 hr. for 60¢.

Runs sewing machine 10 hr. for 2¢.



Runs radio 75 hr. for 25¢.

Electricity does other things, such as running an electric razor, pumping water, heating water, giving light, running television, and many more.

Use the illustrations on page 268 wherever they apply:

1. The average cost per day to run the electric stove is __?__ cents to the nearest tenth of a cent.

2. If the dishwasher runs 1 hour a day, the average cost each day is __?__ cents.

3. The blanket can be used 8 hours a night for a month (30 days) for __?__ cents.

The average cost each night to the nearest cent will be __?__ cents.

4. The clock runs 24 hours a day for 30 days or __?__ hours for __?__ cents.

How much does it cost per day to the nearest hundredth of a cent?

5. You can do a three-hour cleaning each week with the vacuum cleaner for __?__ cents. (Give your answer as a mixed number.)

6. The radio will run __?__ hours for 1 cent.

7. Find out what is a reasonable average time to heat a percolator for a week in a family with two adults.

What would be the cost of using the percolator for this time at the given rate?

8. If the toaster is used 20 minutes each morning, how much would it cost in a month of 30 days?

9. How much does it cost to run the sewing machine for $\frac{1}{2}$ hour?

10. If the sewing machine is used on an average of 10 hours a month for 2 months, what would be the cost of the electricity to run it for the 2 months?

11. What would be the cost of using the ironer for 9 hours? 27 hours?

12. Which one of the appliances pictured on page 268 costs the most to run per hour?

13. Which one of the appliances costs the least to run per hour?

14. Choose the number that is most nearly correct:

The cost of running the ironer for one hour is __?__ times the cost of running the sewing machine for one hour. (6, 12, 18, 24, 30)

15. Do you know why it costs so much more to run the ironer than it does the sewing machine?

16. Which costs more to run, the toaster or the radio? About how many times as much? (Give a whole number as your answer.)

17. Mrs. Hunt's refrigerator motor runs about 5 minutes out of every 15 minutes during the summer.

If it costs $1\frac{1}{2}$ cents an hour when running, how much will it cost during June, July, and August?

18. An electric company estimates that running a clothes drier for 23 hours a month costs about $2.30.

What will be the average cost of running this drier for two hours?

Using electricity

Have you ever bought an electric light bulb? If so, you probably asked for a 40-watt, a 60-watt, or a 100-watt bulb. The bulb was marked 40W, 60W, or 100W.

The amount of *power* required to light a bulb, or to run a vacuum cleaner, or to heat an electric iron is measured in ***watts.***

1. Look at some of the electric light bulbs used in your house and see how many watts are used by each.

2. Look at an electric iron, a toaster, or an electric clock. Does the printed plate on it tell how many watts it requires?

The amount of electricity we use to run electric appliances is measured in units called ***watt-hours.***

When a 100-watt bulb burns for 1 hour, it uses 100 watt-hours of electricity. When a 100-watt bulb burns for 5 hours, it uses 500 watt-hours of electricity ($5 \times 100 = 500$).

3. A 60-watt bulb burning for 3 hours will use $3 \times 60 =$ _?_ watt-hours of electricity.

4. A 40-watt bulb burning for 8 hours will use _?_ watt-hours of electricity.

The number of watt-hours used by an electric appliance is found by multiplying the number of watts the appliance requires by the number of hours it is in use.

5. Look at the illustration above. Is a ***kilowatt-hour*** a larger or a smaller unit than a watt-hour?

For the purpose of determining the cost of electricity the kilowatt-hour is a more convenient unit than the watt-hour.

6. 3000 watt-hours are _?_ kilo-watt-hours.

7. This electric iron used for an hour will use 1000 watt-hours of electricity. In $\frac{1}{2}$ hour it will use _?_ watt-hours, or _?_ kilowatt-hour.

8. An electric train is marked 100 watts. It will take __?__ hours for the train to use 1 kilowatt-hour of electricity.

9. On a hot summer day, a 90-watt electric fan ran for 20 hours without stopping.

It used __?__ watt-hours or __?__ KWHR of electricity that day.

10. A 120-watt radio ran for 10 hours. It used __?__ KWHR of electricity.

11. Mary Hall was interested to find out how much electricity was used by the electric appliances in her house.

On most of the appliances she found a printed plate telling the number of watts required. Then she made the following list:

APPLIANCE	NO. OF WATTS
Clock	2
Small radio	55
Toaster	525
Iron	1000
Sandwich grill	550
Small washing machine	90
Sewing machine	65

In 24 hours the clock uses __?__ watt-hours.

This is approximately __?__ of a KWHR. (For the purpose of estimating, think of 48 watt-hours as 50 watt-hours.)

12. How long will it take the small radio to use a kilowatt-hour? (Give your answer to the nearest hour.)

13. Assuming that the toaster is used 20 minutes a day, in how many days will it use a kilowatt-hour?

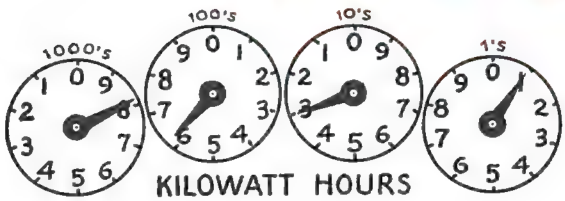
14. Assuming that the small washing machine is used 30 minutes twice a week, how many weeks would it take to use a kilowatt-hour?

15. How much less than a kilowatt-hour of electricity will the sewing machine use in 15 hours?

16. At 5 cents a kilowatt-hour, what is the approximate cost of operating each of the appliances in Ex. 11 for the times given below?

APPLIANCE	TIME IN USE	OPERATING COST
Clock	20 da.	?
Radio	30 hr.	?
Toaster	6 da. @ 20 min. each	?
Iron	2 hr.	?
Sandwich grill	6 meals @ 15 min. each	?
Washing machine	12 weeks @ 1 hr. each	?
Sewing machine	15 hr.	?

17. Which appliance listed in Ex. 11 is the most expensive to operate? the least expensive?



Reading your electric meter

The electricity used in a house or factory is measured by a meter. The meter counts the number of kilowatt-hours (KWHR) used.

The illustration above shows a common type of house meter.

1. The reading on the four dials above is 8631 KWHR. Explain.

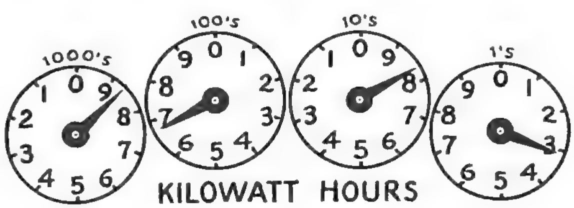
2. The reading on the first dial (at the right) is 1 unit; on the second dial from the right it is _?_ tens; on the third dial it is _?_ hundreds; and on the fourth dial it is _?_ thousands.

3. In the box at the right is shown the number of kilowatt-hours registered on Mrs. Hall's meter on Aug. 15. Below are shown the dials as they looked on Sept. 14. What was the meter reading on Sept. 14?

$$\begin{array}{r} 8000 \\ 600 \\ 30 \\ 1 \\ \hline 8631 \end{array}$$

4. How many kilowatt-hours had the Hall family used between the reading on Aug. 15 and the reading on Sept. 14?

5. If possible, check the kilowatt-hours shown on your electric bill.



Checking your electricity bill

HOME SERVICE ELECTRIC COMPANY
CITY DIVISION · 71 MAIN STREET · COLUMBIA 5

FOR ELECTRIC SERVICE

SEPT. 195-

FROM	TO	METER READINGS PREVIOUS	METER READINGS PRESENT	KILOWATT-HOURS USED	¢ PER KWHR	KWHR BY STEPS	AMOUNT
AUG. 15	SEPT 14	8631	8683	52	5	12	
					4	40	2.20

R. L. HALL
147 OAK ST.
CITY 2

FIRST 12 KWHR—5¢ each
NEXT 53 KWHR—4¢ each
ALL OVER 65 KWHR AT THE ELECTRICAL LIVING RATE $2\frac{1}{2}$¢ EACH

THIS BILL IS DUE ON PRESENTATION

1. Above is Mrs. Hall's bill for electricity used from _?_ to _?_. She had used _?_ KWHR.

2. Read the rates for using electricity as shown on the bill.

3. The bill shows 12 KWHR at 5 cents and 40 KWHR at 4 cents. Where does it show these rates?

4. The total bill is \$2.20. Check the correctness of the amount.

5. Check the correctness of the following bill:

NOV.	DEC.	METER READINGS PREVIOUS	METER READINGS PRESENT	KILOWATT-HOURS USED	¢ PER KWHR	KWHR BY STEPS	AMOUNT
17	17	2491	2576	85	5	12	
					4	53	
					$2\frac{1}{2}$	20	3.02

6. Use the rates shown to figure the amount of the following bill:

FROM MAY	TO JUNE	METER READINGS PREVIOUS	METER READINGS PRESENT	KILOWATT-HOURS USED	¢ PER KWHR	KWHR BY STEPS	AMOUNT
17	16	2827	2889	62	5		
					4		

7. The minimum charge per month is 75 cents. How much is the following bill? Explain it.

FROM JUNE	TO JULY	METER READINGS PREVIOUS	METER READINGS PRESENT	KILOWATT-HOURS USED	¢ PER KWHR	KWHR BY STEPS	AMOUNT
6	16	2889	2899	10	5		

Review problems

1. A railroad ticket from Los Angeles to New York, a distance of 3111 miles, at $.036 a mile, would cost _?_.

2. Harry works in a stationery store. Last week he sent out bills for: $1.75, $1.25, $1.29, $.84, $2.04, $1.98, $.98, $.77, $1.59, and $2.96.

Find the total amount of the bills.

3. John buys shelled peanuts for 40 cents a pound. He roasts and salts them, and sells them in $\frac{1}{4}$-pound bags at 20¢ a bag.

How many bags will he have for sale if he buys 5 lb. of shelled peanuts?

The selling price will be how much greater than the cost price?

4. Jane has a candy recipe that calls for $\frac{2}{3}$ cup of milk. She wants $2\frac{1}{2}$ times as much candy as her recipe makes; so she should use _?_ cups of milk.

5. How much milk should Jane (Ex. 4) use to make $1\frac{1}{2}$ times as much candy as her recipe made?

6. On a map, $\frac{1}{4}$ in. represents 1 yd. How long a line should be drawn to represent $4\frac{1}{2}$ yd.? $5\frac{1}{2}$ yd.? $6\frac{1}{2}$ yd.?

7. On a map, $\frac{3}{4}$ in. represents 1 mi. How long a line should be drawn to represent $1\frac{1}{2}$ mi.? 2 mi.? $2\frac{1}{4}$ mi.?

8. On a map, $\frac{1}{4}$ in. represents 1 yd. How long a distance is represented by a line $2\frac{1}{4}$ in. long? 3 in. long? $3\frac{1}{4}$ in. long? $3\frac{1}{8}$ in. long?

9. On a map in which $\frac{3}{4}$ in. represents 1 mi., how long a distance is represented by a line 1 in. long? $2\frac{1}{2}$ in. long? $3\frac{1}{4}$ in. long? $4\frac{1}{2}$ in. long?

10. How much cheaper is it to buy 24 dozen articles at $4 a gross than at 40 cents a dozen?

11. At 31 dollars for 1000 young pine seedlings, is the cost per seedling nearer 30¢, 3¢, or $\frac{3}{10}$ of a cent?

12. At $125 per 1000 for young sugar maple trees, is the cost per tree nearer $1.25, $.80, or $.10?

13. How many $3\frac{3}{8}$-yard pieces of cloth can be cut from a 25-yard piece?

14. From a piece of material 15 yd. long, how many dress lengths each $3\frac{1}{4}$ yd. long can be cut?

15. When you make a mixture of orange juice and lemon juice in the ratio of 5 to 3, and you use 6 cups of lemon juice, you should use _?_ cups of orange juice.

16. Estimate the total cost of $2\frac{7}{8}$ yd. of velvet at $5.95 a yard and 8 yd. of silk braid at 39¢ a yard.

Compute the cost, and compare with your estimate.

17. A cake recipe calls for $\frac{2}{3}$ cup of flour. To make three times as much cake as the recipe makes, you should use __?__ cups of flour.

18. From a 10-yd. strip of gauze, how many $\frac{3}{8}$-yd. lengths can be cut?

19. If $\frac{1}{8}$ in. on a map represents a mile, a line $1\frac{3}{8}$ in. long represents __?__ miles.

20. At $40.00 per thousand, 100 bricks would cost __?__ dollars.

21. A clerk in a department store gets a discount of 6% on his purchases.

How much would a clerk in the store have to pay for a $3.49 handbag? a 35-dollar suit? 6-dollar shoes?

22. Find the rate of discount on each of the following:

- a 20-dollar dress sold for $16
- a 25-dollar coat sold for $23.75
- a 50-dollar chair sold for $30

23. A commission merchant sold 200 bags of potatoes at $2.00 a bag. He received a commission of 5% of the amount of the sale, earning $__?__.

He turned back to the owner of the potatoes the rest of the money, or __?__ dollars.

24. Mr. Jones shipped 84 barrels of apples to a commission merchant, who sold them for $6 a barrel.

The merchant received a commission of 5%. The freight and other expenses were $32. Find the amount Mr. Jones received.

25. Sue's father is a salesman for a jewelry firm. He receives a weekly salary of $80, and a 5% commission on all the goods he sells each week above 1000 dollars worth.

During the week in which he sold $2000 worth of goods, he earned __?__ dollars.

26. What is the interest on $1000 for a year at 1%? 2%? $2\frac{1}{2}$%? 2.75%? $3\frac{1}{4}$%?

27. What is the interest on $2500 at 4% for a year? for 6 mo.? 4 mo.? 2 mo.? $\frac{1}{2}$ mo.?

28. Estimate the interest on $1000 at 3% for 87 days. Compute the interest and see how close your estimate is to the correct result.

29. Joe estimated the interest on $195 for 25 weeks at 4% as follows:

At 4% the interest on $200 for a year is $__?__; so for 25 weeks the interest would be about __?__ of $__?__. Compare Joe's estimate with the result obtained by the use of the formula:

$$i = 195 \times .04 \times \frac{25}{52}$$

30. A loan for $1240 at 4% was made July 15 and repaid with interest 3 months later. Estimate the interest on the loan. Then compute the interest.

31. At 4%, would the interest on $1000 for a day be about 10 cents, 1 cent, or 5 cents?

Problems and practice

1. A merchant bought a radio for \$60. He estimates that his overhead expense is $33\frac{1}{3}\%$ of the cost; so the cost of the radio plus overhead expense is \$__?__.
How much profit does he make by selling the radio for \$98.00?

2. Find the profit on a radio which cost a merchant \$60 and which sold for \$90. (Consider the overhead as 20% of the sales price.)

3. In Ex. 2, the profit was __?__% of the cost and __?__% of the selling price.

4. While a car used up 15 gallons of gasoline, the speedometer moved from 27,145 to 27,520.
How many miles per gallon did the car travel?

5. A sweeper that cost \$35 sold for \$60. Allowing \$10 for overhead, what was the profit?

6. Mary paid \$1.20 for 3 doz. oranges. Eight of them were spoiled.
Each good orange cost __?__¢, to the nearest cent.

7. Of the 150 boys in a school 96 can swim. Of the 140 girls 87 can swim.
What per cent of each group can swim (to the nearest whole per cent)?

8. An airplane traveling 750 mi. in $2\frac{1}{2}$ hr. would be expected to travel __?__ miles in 2 hr.

9. $7\frac{1}{2}\%$ of the seventh-grade class in one school were 14 yr. old; 15% were 13 yr. old; 40% were 12 yr. old; 15% were 11 yr. old; and the others were 10 yr. old.
__?__% of the class were in the 10-year-old group.

10. At a sale, a 12-dollar camera sold for \$10. The discount was __?__% of the regular price.

11. Don weighs 80 lb. His father predicted that his weight would increase $12\frac{1}{2}\%$ within a year. "Good," said Don, "then I'll weigh __?__ lb."

12. Alice sold 50 subscriptions last year. She wants to increase her sales 40% this year.
If she succeeds, she will sell __?__ subscriptions this year.

13. When the weight of a puppy that now weighs 6 pounds increases 200%, the puppy will weigh __?__ pounds.

14. Don sells apples at a roadside stand. He bought 3 bushels at \$2.00 a bushel.
He sorted out 250 of the largest apples to be sold for 3¢ apiece. He sold the remainder (40 lb.) at 2 lb. for 11 cents.
He estimated his overhead expense to be 15% of the cost. Find his profit.

15. Mr. Williams gets a commission of 15% for selling brushes.

How many dollars worth of brushes must he sell each week to have a weekly income of $60?

16. Jim's father fattens steers. At one time he shipped 75 head of steers to the Lancaster market.

The steers averaged 1200 lb. each, and were sold for $35 a hundredweight. The freight and shipping charges were about $800.

The commission broker charged $1\frac{1}{2}$% commission. How much did Jim's father receive for the steers?

17. A 240-dollar television set was offered for sale at a discount of $37\frac{1}{2}$%, or at a reduction of _?_ dollars.

18. Would you prefer a salary of $20 a week or a commission of 20% of your sales if you believed you were likely to sell about 6 thousand dollars worth of magazines a year?

19. Mr. Johnson's overhead expense is about $33\frac{1}{3}$% of the cost of goods handled.

By selling a table which cost him $24 for $37.50, how much profit, if any, would he make?

20. Bill kept a record of his receipts and expenditures for the month of June. His receipts were $76.43 and his expenditures were $69.78.

He thought, "My account will balance if I have _?_ in cash."

21. A used piano was marked "$150 cash, or $15 down and $15 monthly for 10 months." The *carrying charge,* or the difference between the cash price and the installment price, was _?_ dollars.

22. Tom's father operates a filling station. He bought 2000 gal. of gasoline at 25.6¢ a gallon and sold it for 27.8¢ a gallon.

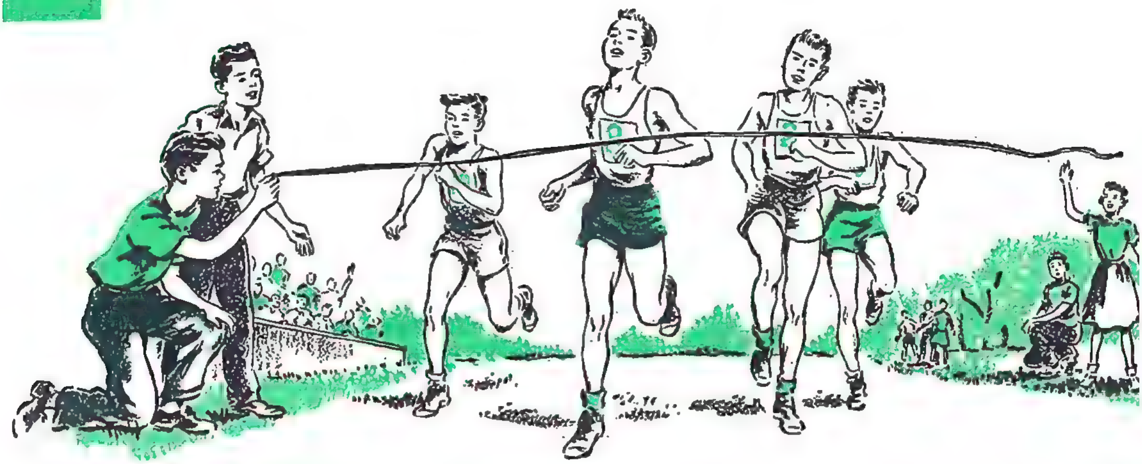
What was his margin on the sale of the 2000 gallons (not allowing for any waste)?

Write these decimals as per cents and as fractions (or mixed numbers) in lowest terms:

	a	*b*	*c*	*d*
23.	.1	.01	.025	.120
24.	.6	.06	.036	.015
25.	.125	.375	.625	.875
26.	$.33\frac{1}{3}$	$.66\frac{2}{3}$	$.16\frac{2}{3}$	$.08\frac{1}{3}$
27.	1.25	2.75	3.50	4.30

Write these per cents as decimals and as fractions (or mixed numbers) in lowest terms:

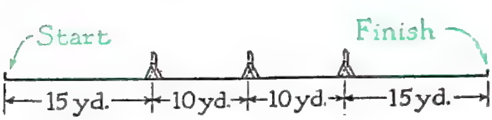
28.	25%	40%	75%	80%
29.	2.5%	3.2%	1.25%	2.75%
30.	150%	225%	125%	275%
31.	2.55%	1.5%	3.25%	3.8%
32.	1.1%	2.4%	12.5%	37.5%



School field day

1. In June the junior high schools of Medfield held their annual field day and track meet. Dan Hill won the first event, the 40-yard dash, in 9.6 seconds. The next boy finished in ten seconds. Dan was __?__ seconds ahead of the second boy.

2. While the hurdles were being set up, the older boys competed in the high jump. Tom Payne from Park School started at 4 ft., 8 in. and went on to 5 ft., 6 in. He then had three tries with the bar at 5 ft., $6\frac{1}{2}$ in. but could not clear it at that height. His jump of 5′ 6″ was the highest jump of the day. The boy who was second jumped 5′ $4\frac{1}{4}$″. Tom won by __?__ in.



3. The runners in the hurdles had to run 50 yd. and clear three 2-foot hurdles. The diagram at the bottom of the left-hand column shows the position of the hurdles. Read from the diagram the running intervals: 15 yd., __?__ yd., __?__ yd., and __?__ yd. What is the total distance?

In this race, the times for first, second, and third places were 10.7 sec., 11.1 sec., and 11.4 sec. What was the difference in time between the winner and the second-place boy? the winner and the third-place boy? the second-place and the third-place boys?

4. For the high jump and running broad jump the boys had prepared jumping pits. The pit for the high jump was 8 ft. by 15 ft.; the one for the broad jump was 5 ft. by 25 ft. Which pit was larger? By how many square feet?

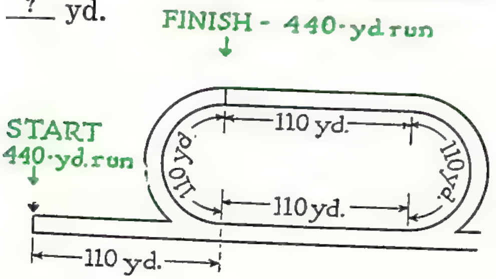
5. All the boys entered in the running broad jump jumped over 15 ft. at the first trials. Before Jim Hill came up for his third try, the greatest jump had been 17 ft. 9 $\frac{3}{4}$ in. When Jim jumped 18 ft. 6 in., everybody cheered. He won the event by _?_ ft. _?_ in.

The previous record for the Medfield schools was 17 ft. $8\frac{1}{4}$ in. Jim's jump set a new record, beating the old record by _?_ in.

6. In three trials Ned Payne put the shot 41 ft. 9 in., 43 ft., and 42 ft. $7\frac{1}{2}$ in. By the rules, his best try, _?_, was counted and he won the event.

7. The girls competed in the basket-ball throw. Barbara Scott's winning throw was 90 ft. 6 in. The official steel tapes were 50 feet long. To measure Barbara's throw in a straight line a rope was used. The full length of the tape was used to measure the first 50 ft. along the rope and then _?_ ft. _?_ in. more were measured.

8. The final event for the day was the $\frac{1}{4}$-mile race for ninth grade boys. A quarter mile is _?_ yd. (See diagram below.) Each straightaway of the track measures _?_ yd. Each arc that makes a curved end measures _?_ yd.



How far from the beginning of the first straightaway is the starting point? Explain why the finish for the quarter-mile race is at the point marked on the diagram.

9. Five boys ran in the quarter-mile race and Bob Shaw won by one tenth second. His time was 59.1 seconds. The boy who placed second finished in _?_ seconds. Bob's time was _?_ second(s) less than a minute.

The following are practice exercises using the same kind of arithmetic that you needed for working the examples for the field day:

10. 11 – 9.3; 10 – 9.6; 12.3 – 11.4

11. 5 ft. $6\frac{1}{2}$ in. – 5 ft. $2\frac{3}{4}$ in.
6 ft. 3 in. – 4 ft. 9 in.

12. $15 + 3\frac{1}{2} + 4\frac{1}{4} + 5\frac{1}{2}$

13. 11.7 – 11.4; 11.4 – 10.7; 10.7 – 9.8

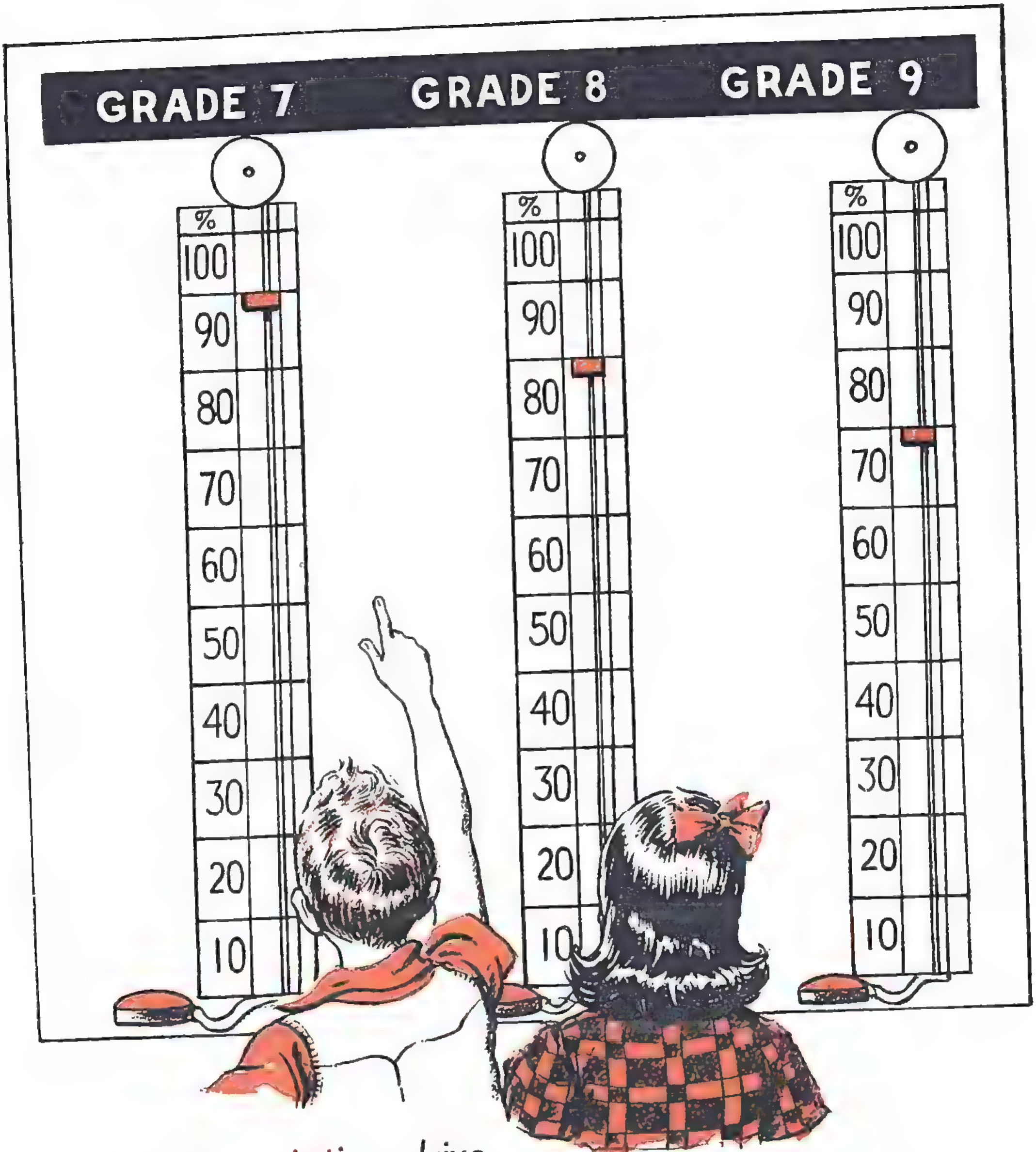
14. What is the area in square feet of a rectangle $9' \times 12'$?

15. Which has the larger area: a $9' \times 12'$ pit or an $8' \times 13'$ pit? How much larger?

16. How many yards are there in a mile? a half mile? a tenth of a mile?

17. Which is the longer distance and how much longer is it?

75 yd. 2 ft.	or	226 ft.
17 ft. 6 in.	or	165 in.
7 yd. 1 ft.	or	27 ft.



Student Association drive

Bill Davis and Ann Black are seventh grade room leaders for the Student Association membership drive. They are looking at the chart to study the daily report.

1. Approximately what per cent of each class has joined?

2. It is near the end of the drive. Which grade is ahead? It has only _?_% to go to reach 100%.

3. The chart shows that the ninth grade is 10% below the eighth grade and the eighth grade is _?_% below the seventh grade.

4. The following table shows the number of students in each grade by rooms. How many students are there in each grade?

SCHOOL ENROLLMENT		
GRADE 7	GRADE 8	GRADE 9
36	33	36
30	34	34
28	36	35
32	32	36
35		31

5. Use the chart on page 280 and your answers to Ex. 4 above to help you find how many students in each grade have joined the Student Association.

Express your answer to the nearest whole number. You should understand that these per cents have been rounded off to the nearest 10%. So your answers are only approximate.

6. Why is 80% of the number of eighth-grade students a smaller number than 70% of the number of ninth-grade students?

7. Use the information in Ex. 4 and your answers to Ex. 5 to help you find what fractional part of the total enrollment has joined the Association.

8. What per cent of the total enrollment has joined the Association?

9. How many more students in each grade must join before the *school* has 100% membership?

10. Bill and Ann kept a daily record of the results of the drive in the seventh-grade rooms. At the end of the drive they made this report:

ROOM	NUMBER IN ROOM	NUMBER OF MEMBERS
1	36	34
2	30	28
3	28	23
4	32	25
5	35	28

What per cent (to the nearest tenth) of the students in each seventh-grade room joined the Association?

Refer to the table in Ex. 4 to answer the questions in Exs. 11–15.

11. What is the total enrollment of the three grades?

12. What fractional part of the total enrollment is in each grade?

13. What per cent of the enrollment is in each grade?

14. How many degrees would each central angle contain to represent these per cents in a circle graph?

15. Make a circle graph to show the distribution of students by grades.

16. Make an enrollment table like that in Ex. 4 for your school.

17. Using the data in Ex. 16 make a circle graph showing what per cent of the students in your school are in each grade.

Buying by mail

WEIGHT IN POUNDS OVER 8 OZ. TO	LOCAL	ZONES						
		1–2 UP TO 150 MILES	3 150 UP TO 300 MILES	4 300 TO 600 MILES	5 600 TO 1000 MILES	6 1000 TO 1400 MILES	7 1400 TO 1800 MILES	8 OVER 1800 MILES
1	$0.18	$0.23	$0.23	$0.24	$0.26	$0.28	$0.30	$0.32
2	.20	.27	.29	.31	.36	.40	.46	.51
3	.21	.31	.34	.38	.45	.52	.61	.69
4	.23	.35	.39	.45	.54	.64	.76	.87
5	.24	.39	.44	.52	.63	.76	.91	1.05
6	.26	.43	.49	.59	.73	.88	1.06	1.23
7	.27	.47	.54	.66	.82	1.00	1.22	1.41
8	.29	.51	.60	.73	.91	1.12	1.37	1.59
9	.30	.55	.65	.80	1.00	1.24	1.52	1.77
10	.32	.59	.70	.87	1.10	1.36	1.67	1.95

Betty White's mother wanted to buy a pressure cooker from a company that does its business by mail. In the catalogue Betty found that the price of the cooker was $11.49 and its weight when packed 7 pounds.

Betty's mother had to send the company a money order for the cooker and the parcel post charges. Betty used a table like the one shown above to find the amount of the postage.

Parcel post charges depend upon the weight of the package and the distance the package will travel. Any fractional part of a pound is considered another whole pound.

1. The Whites live about 200 miles from the mail-order company. In which column in the table would Betty look for the amount of postage?

2. As measured from the mail-order house, in which zone did the Whites live?

3. What amount of postage is necessary for a seven-pound package sent to that zone? What would be the postage for 7 pounds 5 ounces?

4. The total amount to be sent to the company was _?_.

5. Mrs. White sent the money for the pressure cooker by Postal Money Order. At the Post Office Mrs. White made out this application for a money order. Read it. ⟶

No. ....

ISSUING OFFICE STAMP

Application for Domestic Money Order

Spaces below to be filled in by purchaser, or, if necessary, by another person for him

Amount—

USE *FIGURES,* DO NOT SPELL ..12.. Dollars 03 Cents

Purchased by (MRS.) R. L. WHITE

62 FREMONT .... **Street**

City and State } METROPOLIS, MICHIGAN

PURCHASER MUST FOLLOW THESE INSTRUCTIONS TO INSURE PROPER CREDIT AND PAYMENT:

When you receive money order from postal employee you must enter name of person or company to be paid and your name and address or other information to identify payment.

If purchaser fails to enter name of payee, responsibility of Post Office is limited to payment to person whose name appears on order when cashed.

POD Form 6001–X
Sept. 1954

6. The following table shows that the fee for sending the money was _?_.

For orders	
From $0.01 to $5.00	10 cents.
From $5.01 to $10.00	15 cents.
From $10.01 to $50.00	25 cents.
From $50.01 to $100.00	35 cents.

7. In all, the cooker cost _?_.

8. If Mrs. White orders blankets that cost $5.49 and weigh 5 lb. 10 oz. when packed, what will be the total cost including parcel post charges and money order fee? Would Mrs. White save any money by using one money order for the cooker and the blankets? How much?

9. Explain each column of the table in Ex. 6.

10. What is the fee for money orders of the following amounts?

$10.75	$43.25	$90.00
$75.00	$ 4.60	$15.00
$ 7.52	$14.75	$ 8.12

11. What does it cost to send 10 pounds by air express from Springdale to West City, when the express rate is $.278 per pound?

12. By parcel post it costs 61¢ to send a 10-pound package from Springdale to West City. In Ex. 11 you found the air express charge for a similar package to be _?_.

The air express charge is _?_ times as great as the parcel post charge. Answer to the nearest whole number.

Note to Teacher: Post office procedures are changed frequently. Perhaps your students would like to check the current procedure.

Saving money by careful buying

Mrs. McAllister has on her desk a pad like the one shown enlarged. Can you tell what she is doing?

She keeps on her desk newspaper notices of special sales that will help her save money. She knows how much of any one kind of thing she is likely to use in a month or more. If it is something that will keep and she has enough storage space, she buys in large enough quantities to save money. Whenever possible she buys fruit that is *in season*. (What does *in season* mean?) That is the time she can get it cheapest. And she always reads the labels on cans and packages to know how much of anything she is really getting.

Buying at sales

PUBLIC MARKET

SPECIALS FOR TUES. AND WED.

Rinse-Oxydon-Bide-Dux

Large Pkg. 25c

FLORIDA GROWN

Orange & Grapefruit or Grapefruit Juice 4 6 Oz. Cans 25c

CRISP GREEN CALIFORNIA Extra Large

Iceberg Lettuce Head 23c

1. Mrs. McAllister knows that these large packages of soap powder usually cost 29¢. How much will she save by buying 6 packages at this sale?

2. What will one dozen cans of the grapefruit juice cost? How many ounces of juice are there in one dozen of these cans?

3. Mrs. McAllister has been paying 25¢ for a large can of grapefruit juice marked 1 pt. 2 oz. (This is 18 fluid oz. Explain.) How much does she save in buying a dozen cans at this sale?

4. She decided not to buy the extra-large lettuce. A large head might spoil before she could use it. Instead she bought a smaller head for 18¢. Do you consider this careful buying?

5. The regular price of a 4-pound box of cookies is $1.89. At a special sale the box was sold for $1.49. How much would be saved per pound by buying at the sale? (Can you see two ways of doing this exercise? Which is the easier way?)

6. Mrs. McAllister bought two boxes of cookies (Ex. 5) at the sale. How much did she save?

7. At a one-cent sale, Mrs. McAllister saw this sign: "Two cans of scouring powder at the regular price and a third can for 1 cent."

If the regular price is 11 cents per can, what would three cans cost?

8. How much would Mrs. McAllister save per pound by buying bacon at the price shown below?

Friday only. 59c lb. bacon now selling at 3 lb. for 1.00.

Buying in quantities

1. Bill White can buy a 5-pound bag of dog food for 79 cents. He has been paying 20 cents a pound for the same kind of food.

How much can he save on 5 pounds by buying the 5-pound bag?

2. Bill uses 100 pounds of dog food a year. How much can he save by buying 5-pound bags instead of 1-pound bags?

3. It is not wise to buy in large quantities unless you can store safely what you buy.

One year Bill bought a 100-pound sack of dog food for $12.50. Mice ate half of the food. This means that 50 pounds cost him $_?_.

How much would 50 pounds in 5-pound bags cost? How much did he lose by buying the 100-pound sack?

4. Alice's older sister uses typewriter paper for her school work. She can get 100 sheets for 45 cents or 500 sheets for $1.50.

How much will she save on each 100 sheets by buying 500 sheets?

5. What is the cost of 1 lb. of cheese at the 5-oz. rate? at the 8-oz. rate? at the 2-lb. rate?

CHEESE	
5-oz. jar	31¢
8-oz. package	43¢
2-lb. bulk	$1.18

6. Tom Hall's family uses 50 pounds of flour a year, but they have very little storage space. Mrs. Hall buys flour in 10-pound bags.

FLOUR	
5-lb. bag	51¢
10-lb. bag	95¢
25-lb. bag	$2.19

How much more per pound would it cost if she bought the 5-pound bag? (Give your answer to the nearest tenth of a cent.)

How much does she save on 50 lb.? (There are two ways of finding the answer to this question.)

7. Jim Rand's family has more storage space.

How much can Mrs. Rand save by buying four 25-lb. bags instead of ten 10-lb. bags?

8. In the winter Mrs. Stone buys a dozen cans of soup at a time.

- How much does she save per can when she pays $2.22 for a dozen cans marked 20¢ a can? (Give your answer to the nearest tenth of a cent.)
- How much does she save per can when she pays $2.52 for a dozen cans marked 23¢ a can?
- When 6 cans of soup are used a week, how much is saved each week on the 20-cent soup? on the 23-cent soup?

Buying in season

One day in January Edward Parks said, "Mother, I saw strawberries down at the fruit stand today. They made my mouth water. Let's have strawberry shortcake for dinner."

Mrs. Parks said, "Yes, I saw them, too. They cost \$.35 a half-pint box though. Strawberry shortcake would taste good, but we can't afford to buy berries at that price."

"Oh, gee!" said Edward. "Can't we ever have strawberry shortcake?"

"Of course we can, when strawberries are in season. Next June we can get all the berries we want for \$.25 a quart. Then we'll have plenty of shortcake."

1. Edward figured out that strawberries in January cost nearly _?_ times as much as in June. How do you explain such a big difference in price?

2. Appoint a committee to visit a local grocery store. Have them make a report on the in-season and out-of-season vegetables and fruits for sale there today, and the prices of each.

Using the committee's report, what fruits and vegetables do you find are the best buys in your neighborhood today?

3. Early June peaches in the markets near Mary Freeman's home are sold at 2 pounds for 39¢.

How much will 4 pounds cost?

4. In August Mrs. Freeman can buy native peaches at \$1.80 for 24 pounds in a half-bushel basket.

How much less per 4 pounds is this than in June? (See Ex. 3)

5. Can you explain why the native peaches (Ex. 4) are likely to be cheaper than the early June variety?

6. In September Mrs. Freeman bought two half-bushel baskets of peaches for canning. They cost \$2.95 per basket.

How much more did a bushel cost in September than in August?

7. In the winter she can buy fresh tomatoes at 38 cents a pound. In the summer 3 pounds of tomatoes cost 19 cents.

What would 3 pounds cost in the winter? How much less do three pounds cost in the summer?

8. What does 1 pound of tomatoes cost in the summer? The price in winter is how many times as much as the cost in summer? (See Ex. 7)

9. Near Betty White's home the farmers have sweet corn to sell in July and August. A dozen ears in August cost 30¢. If Betty's mother buys ears of corn in the winter in a frozen-food package she pays 23¢ for 2 ears. By buying corn in July and August and not in February Mrs. White can save _?_ on a dozen ears.

Reading labels

1. Jane found a 15-cent can and a 31-cent can of tomato juice. She read the labels on the cans.

- The 15-cent can held 1 pt. 2 oz. or _?_ fluid ounces.
- The 31-cent can held 1 qt. 13 oz. or _?_ fluid ounces.
- The large can cost a little more than _?_ times as much as the small can. It contained _?_ times as much tomato juice.
- Two of the larger cans contain as much as _?_ of the smaller cans.
- Which is the better way to buy the tomato juice, 5 cans at 15¢ each, or 2 cans at 31 cents each?

2. In two different stores, Bill saw jars of school and library paste marked 10 cents each.

In one store the jars were labeled "5 oz."; in the other "$7\frac{1}{2}$ oz." $7\frac{1}{2}$ is how many times 5?

For 10 cents Bill would get _?_ times as much paste by buying the $7\frac{1}{2}$-ounce jar.

3. A tin can of crackers costs 39¢. A package of the same crackers costs 34¢. The label on the can says "15 oz."; on the package, "16 oz."

- Can you figure the cost per pound of each? How much more per pound do the crackers in the can cost than the crackers in the package?
- Is there an advantage in buying them in the can?

4. Small cans of evaporated milk sell at 4 for 25¢. A larger can sells for 13¢.

- The label on the small can states that it contains $5\frac{1}{3}$ fluid ounces. How many fluid ounces would 12 small cans contain? What would be the total cost of these cans?
- The larger can contains 13 fluid ounces. How many of the larger cans would it take to get the same amount of milk as in the 12 small cans?
- What would be the total cost of these cans? Which is the better buy?

5. Ann went to The Corner Grocery Store to buy canned tomatoes. On the shelves she saw three different sizes of cans, each size at a different price. She read the net weight of the contents of each can on the label. Then she compared them as follows:

PRICE	NET WEIGHT
17¢	10 oz.
25¢	1 lb. 3 oz.
32¢	1 lb. 10 oz.

- If Ann bought two of the smallest cans she would have only _?_ ounce more than in the 25-cent can, but she would pay _?_¢ more for them.
- If Ann bought three of the small cans, she would have _?_ ounces more than in the largest can, but she would pay _?_ cents more than the largest can would cost.
- Find the cost per pound for the tomatoes at the rates asked for each of the cans.

Riding by train

1. Mrs. Rowe, Mary, and Jim will travel by train from Boston to Chicago. They will return in ten days. What is meant by a *round-trip ticket?* Why does a railroad sometimes offer a round-trip ticket for less than two separate fares?

2. Does Mrs. Rowe buy 1, $1\frac{1}{2}$, 2, $2\frac{1}{2}$, or 3 round-trip tickets? Explain.

3. In the illustration below Mrs. Rowe is at the ticket window.

How much does she have to pay the agent for the round-trip fares?

4. Mrs. Rowe also has to pay a 15% tax on the price of the tickets. How much does the tax amount to? How much is her total cost for the round trip for all three?

Review problems

1. Sue bought a 15 lb. 6 oz. turkey for 48 cents a pound.

She estimated that there were at least 30 servings in the turkey and that the cost per serving would be about __?__ cents.

2. Which is cheaper per pound: a $3\frac{3}{4}$-lb. piece of beef for \$3 or a $2\frac{7}{8}$-lb. piece for \$2.40? How much?

3. Mr. Bradshaw sells milk at 6 cents a pound.

He figures that a pound of milk is about a pint of milk. He gets __?__ cents a quart.

4. A merchant sold a pair of shoes which cost him \$3.75 for \$5.00. He estimated that his overhead expense amounted to 20% of the cost of his goods.

Compute his profit. The profit was __?__% of the cost and __?__% of the selling price.

5. The base of a triangular-shaped field is 60 rd. and the altitude 40 rd. At \$200 an acre, the field is worth __?__ dollars.

6. At \$4.50 a square yard, the cost of the linoleum needed for a room 12 ft. by 15 ft. 6 in. is __?__ dollars.

7. The Smiths flew from Los Angeles to New York (2450 mi.) in $9\frac{1}{2}$ hr.

They were flying at an average rate of __?__ miles per hour.

8. If a $4\frac{1}{2}$-yd. remnant of cloth sells for \$2, a $3\frac{3}{4}$-yd. piece at the same rate would cost __?__.

9. Caroline paid 98¢ for $\frac{5}{8}$ yd. of chintz. At this rate, what was the price per yard?

10. Albert read that an automobile went 1 mile in 17.5 seconds, or at the rate of __?__ miles an hour.

11. Each inch of a certain metal bar expands .0004 in. when the temperature is increased by 1200°.

How much does a bar 12.6 in. long expand when the temperature is increased by 1200°?

12. Find the margin on 144 bars of soap bought for \$12.80 and sold at 2 for 35¢.

13. An authority on school buildings believes that there should be at least 200 cu. ft. of space per pupil in a schoolroom.

One room is 36 ft. long, 24 ft. wide, and 12 ft. high. According to the authority on buildings, could as many as 50 pupils be seated in the room?

14. A grocer paid 15¢ a box for 100 boxes of berries. Ten boxes spoiled before he could sell them and he had to throw them away.

He sold the remaining boxes of berries for 25¢ a box. Find his margin on the berries.

Miscellaneous

Group 1

1. Add:

$$\begin{array}{r} 5904 \\ 8945 \\ 6174 \\ \underline{8906} \end{array}$$

2. Subtract:

$$\begin{array}{r} 97641 \\ \underline{54432} \end{array}$$

3. Subtract:

$$\begin{array}{r} 5000 \\ \underline{3821} \end{array}$$

4. Multiply:

$$\begin{array}{r} 984 \\ \underline{63} \end{array}$$

5. Divide:

$84\overline{)2688}$

6. $\frac{1}{2} + \frac{1}{4}$

7. $\frac{2}{3} + \frac{3}{4} + \frac{5}{6}$

8. $4\frac{1}{4} + 3\frac{1}{2} + 6\frac{5}{8}$

9. $\frac{1}{2} \times \frac{1}{2}$

10. $\frac{3}{4} \div \frac{3}{4}$

11. $\frac{3}{4} - \frac{3}{4}$

12. $8 = \frac{?}{5}$

13. 3.28×2.7

14. $4\frac{1}{2} \times 3$

15. $1.3\overline{)1.69}$

16. Reduce $\frac{12}{18}$.

17. Change $\frac{3}{4}$ to twelfths.

18. Change $3\frac{7}{8}$ to an improper fraction.

19. Change $\frac{17}{5}$ to a mixed number.

20. $.2 \times .2$

21. $.2 + .2$

22. $.2 \div .2$

23. $346 \div 100$

24. 346×10

25. Round off 4,567,892 to the nearest million.

26. Divide 12 by .4.

27. Find 7% of 48.

28. Find 26% of 432.

29. 8 is what per cent of 16?

30. If $\frac{1}{2}$ of a number is 6, what is the number?

31. Find the average of 37, 50, 19, 74, and 20.

32. Write in figures: ten thousand one.

33. Write in figures: forty thousand four hundred four.

34. Write in words the number 100,040.

35. How much change should you get from a ten-dollar bill if your purchases in the market come to $5.43?

36. If 64 is the dividend and 4 is the divisor, what is the quotient?

37. If you subtract 6 days from 1 week 2 days, what is your answer?

38. 4000 is the same as 3000 plus 900 plus 90 plus __?__.

39. 24×36 is the same as $20 \times 36 + \underline{\ ?\ } \times 36$.

40. If $7 \times N = 21$, what is the value of N?

41. If $7 + N = 21$, what is the value of N?

Miscellaneous

Group 2

1. Add $324.16, $957.30, $800, and $94.20

2. Subtract $593.67 from $983.04.

3. Divide 322.5 by .75.

4. Multiply 8.23 by 2.7.

5. Add $3\frac{1}{2}$, $2\frac{1}{4}$, and $6\frac{5}{8}$.

6. Subtract $7\frac{5}{6}$ from $13\frac{1}{3}$.

7. Multiply $4\frac{1}{2}$ by $2\frac{2}{3}$.

8. Find $37\frac{1}{2}$% of 68.

9. Find 15% of 68.

10. Divide 27 by 1000.

11. 7 is what per cent of 13, to the nearest whole per cent?

12. Express 24795 to the nearest hundred.

13. If you increase 64 by 50% of itself, what is the resulting number?

14. If *AB* is a line with *C* a point on it so that $AC = 2''$ and $CB = 3''$, what is the ratio of *AC* to *CB*?

15. In Ex. 14, what is the ratio of *AC* to *AB*?

16. At what price should a merchant sell a watch which cost him $75 if he wishes to have a margin of 60% of the cost?

17. A farmer raised 600 bushels of wheat last year. This year he reduced his acreage of wheat by 10%. At the same rate per acre, he will raise __?__ bushels.

18. A local commission merchant charged $400 for selling $10,000 worth of apples. Find his rate of commission.

19. If you subtract 24 from 2928, subtract 24 from the remainder, and so on, how many times would you subtract 24 before you had a remainder of zero?

20. If $\frac{N}{3} = 15$, what is the value of N?

21. When it is 4 P.M. on Dec. 25 in New York City, what time is it in Los Angeles?

22. How many $\frac{1}{2}$ inches are there in a yard?

23. How many $\frac{3}{8}$'s are there in 6?

24. $2\frac{3}{5}$ has the same value as $1\frac{?}{5}$.

25. To divide a number by $\frac{3}{5}$, I __?__ it by $\frac{5}{3}$.

26. What is the cost of $4\frac{5}{8}$ yd. of ribbon at 27 cents a yard?

Miscellaneous

Group 3

1. The Abbott's apple orchard contains 144 trees. Don Abbott estimates that each tree will yield on the average $1\frac{3}{4}$ bushels of saleable apples. At that rate, what will the apple crop be worth at \$2 a bushel?

2. Ruth bought 3 gallons of honey at \$4 a gallon. She planned to put it in quart jars and to sell it at a price so that she would gain 25% of the cost. (Disregard cost of jars.) How much should she charge for a jar of honey?

3. At \$1.20 a pound for grass seed, how much will it cost to buy seed for a lawn 150 ft. by 60 ft.? (1 lb. of seed for 200 sq. ft.)

4. Jack is building a ladder 24 ft. long with rungs 12 in. apart. The top and bottom rungs are to be 12 in. from the ends. How many rungs must Jack plan for?

5. To move a small chicken house, Mr. Jones placed it on rollers each with a radius of 6 in. How far will the house move with each turn of a roller?

6. Mr. Johnson paid \$36 for a desk and sold it for \$48. His overhead expenses are 25% of the cost of his goods. What was his profit on this sale?

7. Frank sold a forty-nine dollar bicycle for \$42. What was the per cent of loss to the nearest whole per cent?

8. A sweater was bought for \$4. This amount was a 20% discount on the marked price. Find the marked price.

9. Using c, m, o, p, and s to represent the number of dollars in the cost, margin, overhead, profit, and selling price, respectively, which of the following statements are true?

$c + m = s$	$m = o + p$
$s - c = m$	$p = s - c - o$
$c + m + o = p$	$p + o + c = s$

10. A merchant paid \$24 for a radio. He wished to sell so that his margin would be 25% of the selling price. Find the selling price.

11. If the radius of any circle is increased 50%, the area will be increased _?_%.

12. If the lengths of the sides of a cube are decreased 50%, the volume of the cube is decreased _?_%.

13. Schaefer's Store sold Jim a camera for \$64.49. What discount was allowed if the original price was \$121?

Be your own teacher

Back in 1829, when John Quincy Adams was President of the United States, many students at the seventh-grade level could solve the following problems without the help of a teacher. Can you? (These problems appeared in an arithmetic textbook published in 1829.)

1. The distance from New York to Baltimore is 197 miles. Two travelers set out at the same time in order to meet; A from New York towards Baltimore, and B from Baltimore towards New York. When they met, which was at the end of 6 days, A had traveled 3 miles a day more than B. How many miles did each travel per day?

2. If 7 men can reap 84 acres of wheat in 12 days, how many men can reap 100 acres in 5 days?

3. If 20 bushels of wheat are sufficient for a family of 15 persons 3 months, how much will be sufficient for 4 persons 11 months?

4. A gentleman bequeathed an estate of \$12,500 between his wife and son. The son's share was $\frac{7}{9}$ of the share of the wife. What was the share of each?

5. If a man can do $\frac{3}{8}$ of a piece of work in one day, in what part of a day can he do $\frac{1}{8}$ of it? How long will it take him to do the whole?

6. A farmer hired two men to mow a field. One of them could mow $\frac{1}{3}$ of it in a day, and the other $\frac{1}{5}$ of it. What part of it would they both together do in a day? How long would it take them both to mow it?

7. Divide 25 apples between two persons, so as to give one 7 more than the other.

8. A man sold some calves and some sheep for \$108; the calves at \$5, and the sheep at \$8 apiece. There were twice as many calves as sheep. What was the number of each sort?

9. There is a fish whose head is 16 inches long, his tail is as long as his head and half the length of his body, and his body is as long as his head and tail. What is the length of the fish?

10. A man bought some lemons at 2 cents each, and $\frac{3}{4}$ as many at 3 cents each, and then sold them all at the rate of 5 cents for 2, and by so doing gained 25 cents. How many lemons did he buy?

11. A man and his wife found that when they were together, a bushel of corn would last 15 days, but when the man was absent, it would last the woman alone 27 days. What part of it did both together consume in 1 day? What part did the woman alone consume? How long would it last the man alone?

Holding your ground

▶ Oral review

1. Multiply 2.1 by 10.

2. What is the value of the 6 in 974.362?

3. If 1 inch on a map represents 200 miles, what will $4\frac{1}{2}$ inches represent?

4. A southbound train left Chicago at 8:45 P.M. and arrived at its destination in the same time zone at 9:30 A.M. the following day. How much time did the trip take?

5. Change 30 months to years.

6. Reduce $\frac{12}{16}$ to lowest terms.

7. Change $\frac{2}{3}$ to 24ths.

8. Change $\frac{68}{8}$ to a mixed number.

9. Change $9\frac{4}{5}$ to an improper fraction.

10. What is the perimeter of a square that is 3″ on a side? What is the area?

11. If, in a triangle, two angles are 50° and 80°, how large is the third angle?

12. What part of a complete rotation is 60°?

13. 7 ft. 3 in. = _?_ in.

14. $4\frac{1}{3}$ ft. = _?_ in.

15. 24 oz. = _?_ lb.

16. $25 is 10% of what amount of money?

17. If $\frac{5}{8}$ yd. of cloth costs 50 cents, what is the cost per yard?

18. What is the sum of 128 and 49? of 167 and 59? of 286 and 79?

19. 25% is represented on a circle graph by an angle of _?_°.

20. Find the interest on $400 for 4 mo. at 6%.

21. 2,750,863 rounded off to the nearest thousand would be _?_.

22. If an article which costs $24 is sold for $32, the margin is _?_% of the cost, but only _?_% of the selling price.

23. Express 27.899 to the nearest hundredth.

24. MCMXIX is the Roman numeral for _?_.

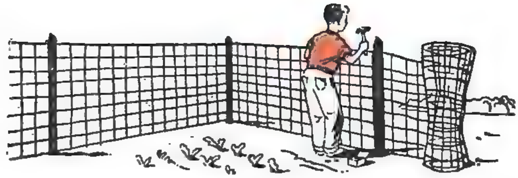
25. 1,000,200,000 is read _?_.

26. When we say two numbers are in the ratio 2 to 5, we mean that the smaller number is _?_ of the larger number.

27. Is $\frac{2}{3}$ nearer to 60% or 70%?

28. If the radius of a circle is $2\frac{3}{4}$″, the diameter is _?_″.

Holding your ground



Written review

1. What is the area of a rectangle that is $3\frac{1}{2}$ inches long and $2\frac{1}{2}$ inches wide?

2. What is the circumference of a circle whose diameter is 12 inches? Use $\pi = 3.14$ and give the answer to the nearest tenth of an inch.

3. A candy recipe calls for $3\frac{1}{2}$ cups of sugar, $\frac{1}{2}$ cup of butter, $2\frac{1}{2}$ cups of milk, and $2\frac{1}{2}$ squares of chocolate. If you wish to make three times as much as the recipe would make, how much of each ingredient will you use?

4. If a bird can fly $21\frac{1}{3}$ miles an hour, how far can it fly in 15 minutes?

5. What is the area of a square $3\frac{3}{4}'$ on a side?

6. $24\overline{)5532}$ $\qquad$ $336\overline{)20160}$

7. Add $7\frac{2}{3}$ and $5\frac{5}{6}$.

8. Change $\frac{165}{15}$ to a whole number.

9. $36 \div \frac{3}{4}$ $\qquad$ $2\frac{3}{4} \times 16\frac{1}{2}$

10. 8.34×0.7 $\qquad$ $25\overline{)1}$

11. From 4 hr. 17 min. take 2 hr. 35 min.

12. Find 8% of 432.

13. 20 is what per cent of 35, to the nearest per cent?

14. A small radio sold at \$16. This was 20% off. What was the regular price?

15. Subtract $1\frac{5}{6}$ from $4\frac{5}{12}$.

16. $5\frac{3}{4} \times 68$ $\qquad$ $.07\overline{)85.4}$

17. Mr. Perkins traveled 63 miles on $3\frac{1}{2}$ gallons of gasoline. What was his average mileage per gallon?

18. How much does an agent earn in a week in which he sells \$1800 worth of goods and his rate of commission is 15%?

19. Subtract $3\frac{2}{3}$ from $10\frac{1}{6}$.

20. 10 in. = _?_ ft. $\qquad$ 52 oz. = _?_ lb.

21. 19 is what per cent of 23, to the nearest whole per cent?

22. How much must you invest at 5% in order that your yearly interest may be \$1000?

23. If the numerator of $\frac{3}{5}$ is multiplied by 4, and the denominator remains unchanged, the answer is _?_ times as large as the original fraction.

24. If the denominator of $\frac{3}{5}$ is multiplied by 4, and the numerator remains unchanged, is the answer 4 times as large as the original fraction, $\frac{1}{4}$ as large, or .4 as large?

Review Test I

Each question has *five* possible answers lettered from *a* to *e*.

Write the numbers 1–14 in a column and after each number write the letter which corresponds to the correct answer. If an answer is not given write "e" opposite the number of the question.

QUESTIONS — ANSWERS

1. Multiply:
467
300

a 1401 *b* 14010
c 141100 *d* 140100
e not given

2. Divide:
52)1924

a 36 *b* 38
c 32 *d* 52
e not given

3. Add:
122083
452348
270684

a 845115 *b* 745115
c 845105 *d* 945115
e not given

4. Subtract:
10
$9\frac{1}{4}$

a $1\frac{3}{4}$ *b* $\frac{3}{4}$
c $1\frac{1}{4}$ *d* $19\frac{1}{4}$
e not given

5. Subtract:
948257
329168

a 619189 *b* 629089
c 519089 *d* 619089
e not given

6. Add:
$\frac{1}{8}$
$\frac{3}{4}$

a $\frac{7}{8}$ *b* $\frac{1}{2}$
c $1\frac{1}{8}$ *d* $\frac{3}{32}$
e not given

7. Multiply:
2.732
100

a 2732.0 *b* .002732
c 273.2 *d* 27.32
e not given

QUESTIONS — ANSWERS

8. Multiply:
$\frac{4}{7} \times \frac{3}{14}$

a $2\frac{2}{3}$ *b* $\frac{3}{8}$
c $4\frac{1}{6}$ *d* $\frac{6}{49}$
e not given

9. $\frac{2}{5} = \underline{\ ?\ }\%$

a 2 *b* 5
c 40 *d* $\frac{2}{5}$
e not given

10. 8 is what part of 12?

a $\frac{1}{8}$ *b* $\frac{2}{3}$
c $\frac{3}{4}$ *d* $\frac{1}{2}$
e not given

11. 8 is what per cent of 12?

a $12\frac{1}{2}$ *b* $66\frac{2}{3}$
c 50 *d* 75
e not given

12. Mrs. Jones wishes to make 12 curtains each $2\frac{2}{3}$ yards long including hems. How much material should she buy?

a 32 yd. *b* 33 yd.
c 26 yd. *d* 14 yd.
e not given

13. Tom earns 80 cents an hour. If he works 40 hours a week for 5 weeks, how much will he earn?

a \$160 *b* \$16
c \$1600 *d* \$320
e not given

14. Last year Mr. Thurston worked 8 hours a day for 200 days at \$1.95 an hour.

If he works the same number of hours this year at 13 cents an hour increase, how much more will he earn?

a \$1728 *b* \$308
c \$208 *d* \$108
e not given

Review Test II

See the directions on page 297.

QUESTIONS — ANSWERS

1. Multiply:
568
370

a 21016 *b* 210160
c 211160 *d* 110160
e not given

2. 20% of $18 = __?__

a $360 *b* $.36
c $3.60 *d* $9.00
e not given

3. .04 = __?__%

a 25 *b* 40
c 4 *d* $\frac{1}{4}$
e not given

4. Subtract:
$\frac{5}{8}$
$\frac{1}{4}$

a 1 *b* $\frac{3}{4}$
c $\frac{1}{2}$ *d* $\frac{7}{8}$
e not given

5. Multiply:
.032
.18

a .0576 *b* .00576
c .00566 *d* .00567
e not given

6. $6\% = \frac{?}{100}$

a 94 *b* 60
c $16\frac{2}{3}$ *d* 6
e not given

7. $\frac{6}{10}$ = __?__%

a 8 *b* 60
c 30 *d* $62\frac{1}{2}$
e not given

8. Subtract:
6000
4567

a 2543 *b* 2433
c 2533 *d* 1543
e not given

9. $\frac{3}{7}$ = __?__%

a 42 *b* 43
c .42 *d* .43
e not given

10. $\frac{4}{5}$ of __?__ = 20

a 25 *b* .80
c 16 *d* 80
e not given

QUESTIONS — ANSWERS

11. $\frac{1}{3} \div 4 =$ __?__

a $\frac{1}{12}$ *b* $1\frac{1}{3}$
c 12 *d* $\frac{3}{4}$
e not given

12. Add:
$7\frac{3}{4}$
$12\frac{5}{6}$
$25\frac{1}{2}$

a $46\frac{1}{2}$ *b* $44\frac{1}{12}$
c $45\frac{1}{12}$ *d* 46
e not given

13. $\frac{8}{15} \times 2\frac{11}{12}$

a $\frac{7}{9}$ *b* $4\frac{2}{3}$
c $1\frac{1}{2}$ *d* $1\frac{5}{9}$
e not given

14. $.25\overline{).6}$

a 2.4 *b* 24
c .024 *d* .24
e not given

15. $.36\overline{)48.6}$

a 1.35 *b* .135
c 0.135 *d* 13.5
e not given

16. 5¢ for $1\frac{1}{3}$ oz. is __?__¢ a lb.

a 4 *b* $6\frac{1}{4}$
c 60 *d* 12
e not given

17. At a sale Bob paid $7.60 for a sweater marked $8.00. What was the per cent of discount?

a 40 *b* .40
c 5 *d* $\frac{1}{5}$
e not given

18. Dick's chicken run is a square 20 feet on a side. Bill has a chicken run 50 feet square. Bill has __?__ square feet more of chicken run than Dick.

a 30 *b* 120
c 1900 *d* 350
e not given

The 100 addition combinations

7	2	2	2	4	4	3	4	1	9
1	9	5	8	4	1	1	0	8	9
7	2	6	5	3	1	9	8	1	1
7	0	1	4	3	1	2	8	3	6
1	2	0	5	2	0	7	1	0	8
7	1	0	5	2	1	2	9	5	1
6	0	3	0	2	3	4	0	6	8
2	4	6	2	4	0	5	8	0	3
8	6	1	9	5	6	3	4	1	9
2	4	4	1	0	6	2	3	5	0
2	9	0	6	3	3	3	2	3	6
6	3	6	5	8	4	9	3	5	3
7	2	8	4	8	1	5	4	1	5
3	7	7	8	0	0	2	2	2	3
0	0	5	7	8	7	5	9	6	6
3	9	1	0	5	9	8	7	8	9
5	7	8	9	5	8	8	4	7	4
7	8	4	6	9	9	6	7	5	9
9	9	6	0	5	4	7	7	9	3
5	4	7	7	6	6	6	4	8	7

The 100 subtraction combinations

6	2	5	6	3	7	4	5	8	6
1	1	2	3	1	1	3	5	4	5
9	4	9	9	5	5	1	8	4	6
8	4	1	9	3	4	1	1	2	6
3	3	7	5	0	3	5	9	8	10
3	2	7	1	0	0	0	6	2	4
8	9	7	6	9	7	12	10	8	11
8	3	3	0	0	2	6	7	6	2
6	10	10	7	9	8	4	2	7	6
2	1	2	6	5	7	1	2	5	4
8	13	15	11	11	11	9	10	10	14
5	6	8	7	5	8	2	3	9	7
7	10	12	12	1	8	7	12	10	10
4	8	4	8	0	3	0	9	5	6
8	2	15	12	4	14	13	16	14	17
0	0	9	3	0	9	4	9	5	9
9	17	15	13	13	16	13	13	11	14
7	8	7	9	5	7	7	8	3	6
9	15	12	14	12	11	11	16	18	11
4	6	5	8	7	4	6	8	9	9

The 100 multiplication combinations

6 2	0 4	3 6	0 2	2 4	3 0	4 5	0 8	6 0	8 3
8 2	6 4	1 4	9 1	5 0	6 6	3 2	4 3	1 5	9 0
2 6	9 3	0 6	6 5	3 8	3 4	3 9	2 3	3 5	6 3
7 3	2 7	8 7	4 8	8 0	1 0	5 2	4 2	1 2	5 3
0 3	0 9	5 1	7 0	8 5	7 9	5 8	9 7	6 8	6 9
7 1	2 9	2 5	2 8	4 4	4 1	3 1	4 0	1 8	9 9
7 7	2 0	6 1	5 4	3 3	1 1	9 2	8 8	1 3	1 6
1 7	2 1	0 0	5 5	2 2	0 1	7 2	1 9	0 5	8 1
9 5	9 4	6 7	0 7	5 6	4 6	7 6	7 4	9 8	3 7
5 7	7 8	8 4	9 6	5 9	8 9	8 6	4 7	7 5	4 9

The 90 division combinations

$5\overline{)30}$	$2\overline{)18}$	$1\overline{)4}$	$5\overline{)25}$	$3\overline{)0}$	$7\overline{)35}$	$1\overline{)5}$	$4\overline{)8}$	$9\overline{)0}$
$1\overline{)3}$	$5\overline{)35}$	$3\overline{)3}$	$9\overline{)81}$	$7\overline{)42}$	$8\overline{)8}$	$7\overline{)28}$	$8\overline{)0}$	$4\overline{)12}$
$3\overline{)6}$	$2\overline{)16}$	$5\overline{)40}$	$7\overline{)49}$	$1\overline{)2}$	$8\overline{)16}$	$4\overline{)16}$	$9\overline{)9}$	$7\overline{)21}$
$2\overline{)14}$	$3\overline{)9}$	$7\overline{)56}$	$5\overline{)45}$	$9\overline{)72}$	$6\overline{)0}$	$8\overline{)24}$	$7\overline{)14}$	$5\overline{)20}$
$1\overline{)1}$	$7\overline{)63}$	$3\overline{)12}$	$5\overline{)15}$	$4\overline{)20}$	$7\overline{)7}$	$9\overline{)63}$	$6\overline{)6}$	$8\overline{)32}$
$8\overline{)56}$	$2\overline{)12}$	$5\overline{)10}$	$4\overline{)24}$	$7\overline{)0}$	$9\overline{)54}$	$6\overline{)12}$	$3\overline{)15}$	$8\overline{)40}$
$2\overline{)10}$	$5\overline{)5}$	$4\overline{)28}$	$6\overline{)54}$	$9\overline{)45}$	$6\overline{)18}$	$4\overline{)4}$	$3\overline{)18}$	$8\overline{)48}$
$5\overline{)0}$	$4\overline{)32}$	$6\overline{)48}$	$9\overline{)36}$	$6\overline{)24}$	$1\overline{)6}$	$3\overline{)21}$	$2\overline{)2}$	$1\overline{)0}$
$4\overline{)36}$	$6\overline{)42}$	$9\overline{)27}$	$6\overline{)30}$	$2\overline{)8}$	$4\overline{)0}$	$8\overline{)64}$	$2\overline{)0}$	$3\overline{)24}$
$6\overline{)36}$	$2\overline{)6}$	$1\overline{)7}$	$9\overline{)18}$	$1\overline{)8}$	$8\overline{)72}$	$2\overline{)4}$	$1\overline{)9}$	$3\overline{)27}$

To the teacher

This series is planned to develop progressively the important concepts, relationships, and computational skills needed in arithmetic. In doing this, the books of the series organize the learning into a meaningful system of related ideas; they make maximum use of children's needs for number; and they provide the practice, self-diagnosis, and remedial work required to make learning permanent. Most careful attention has been given to the problem of reading for understanding. The books are the outcome of years of research and classroom experience.

For the textbook for each grade there is available a *Teacher's Guide*. The *Guide* contains concrete suggestions for making the learning of arithmetic meaningful and interesting. It provides helps for utilizing the textbook material most effectively. It also gives a concise statement of the authors' philosophy and psychology of teaching the subject.

NOTE 1 (*Pages 13, 18, 29, 33*). Have the students test their mastery of the basic addition facts on page 299 from time to time during the year. This is necessary if mastery is to be maintained. Follow this procedure with the basic facts in subtraction, multiplication, and division (pages 300–302). Caution the students *never to write in their books.*

NOTE 2 (*Pages 15, 20, 30, 164*). Mental arithmetic is now being emphasized in the teaching of mathematics. Have the student tell "how he thinks" when he computes mentally. Encourage students to evaluate the various methods of doing a mental computation.

NOTE 3 (*Page 25*). In general, graphs show the results of only approximate, or rounded off, data. For example, in Ex. 1, the horizontal scale should be ruled to show the flight rate to the nearest 10 miles per hour. The location of the ends of the bars for the rates halfway between rules may be estimated. In Ex. 4, the horizontal scale should be ruled in feet and halves of a foot. Then the intermediate positions for the ends of bars may be located by estimation.

NOTE 4 (*Pages 34–36*). The treatment of division in this text will make the process meaningful and sensible. Too often the student has no understanding of the process. The authors urge you to teach pages 34–36 as written, even though your students may know how to divide.

NOTE 5 (*Page 37*). These exercises teach the student how to use the *inverse* relationship between multiplication and division. The answers to the exercises are to be found by using the concept of "inverse relationship," not by using the axioms of algebra.

NOTE 6 (*Page 38*). The sums on page 13 may be used for practice in estimating. In Exs. 11, 15, and 16, round off to the nearest dollar; in Exs. 12, 13, and 14, round off to the nearest hundred; in Exs. 17, 18, and 19, round off to the nearest thousand.

NOTE 7 (*Page 72*). These exercises are designed to deepen the student's understanding of the operations of arithmetic, not to give him drill in performing the operations. They provide practice in thinking.

NOTE 8 (*Pages 84–86, 119–121, 165–167, 291–293*). See *Teacher's Guide* for details concerning the use of these pages.

NOTE 9 (*Page 117*). In Exs. 24–33, the letter N stands for "what number?" In each exercise N is a missing multiplier or a missing multiplicand.

NOTE 10 (*Pages 168, 256, 294*). On these pages, entitled "Be your own teacher," are exercises designed to help children realize that they can, without teacher or book guidance, think out for themselves solutions to arithmetic situations that are new to them. Students will of course use a great variety of methods of solving the problems. Seldom will they use conventional methods. These pages will be welcomed by the teacher who wishes to challenge her more able students to do independent, creative, quantitative thinking. The solutions offered should be compared and evaluated by the participating students. Do not attempt to teach conventional methods.

ACKNOWLEDGMENT

For permission to reproduce certain illustrative materials,
both authors and publishers wish to thank the
American Hereford Association page 135

Pages 305 to 314, and the back cover, are not required. They had the following information in order: Tables For Reference, Glossary, and Index. This is the last page.